Axiolab A Reflected-Light Microscope

Operating Manual

Knowledge of this instruction manual is necessary for device operation. Please get familiar with its contents and especially the precautions for safe device operation.

Changes due to further technical development are reserved; this manual is not covered by an update service.

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NOTES

- The figures integrated in the text each have a figure number and a caption, e.g. "Figure 2-7" signifies: the figure in Section 2 with the serial number 7. In each figure, details discussed in the text have been assigned with a reference line marking and an item number. In the running text, "Mains cable (2-7/**1**)" signifies: in Figure 7 of Section 2, the mains cable is marked with the item number **1**.
- Refer to the annex for explanations of the abbreviations.
- This instruction manual refers to the Axiolab A microscope equipment including accessories (see page 1-5 following).

  This manual can also be used for other instrument versions.

Notes on Instrument Safety

The Axiolab A reflected-light microscope was designed, produced and tested in compliance with DIN 61010-1 (IEC 1010-1), Safety requirements for electrical measuring, control and laboratory instruments, and meets the requirements of appendix I of directive 73/23/EC and the relevant CSA and UL directives. The instrument meets the requirements of the EC directive 89/336/EC and the EMC legislation of November 9th 1992. This operation manual includes information and warnings which must be observed by the user.

The following warning and information symbols are used in this manual:

NOTE
This symbol is a warning which you must observe under all circumstances.

CAUTION
This symbol is a warning which indicates a hazard to the instrument or instrument system.

CAUTION
This symbol is a warning which indicates a hazard to the user of the instrument.

CAUTION
Hot surface!

CAUTION
Disconnect the instrument from the line before opening it!

The Axiolab A microscope, including original accessories, may only be used for the microscope techniques described in this manual.

Particular attention must be paid to the following warning notes:

The manufacturer cannot assume any liability for any other applications, possibly also involving individual modules or single parts. This also applies to all service or repair work which is not carried out by authorized service personnel. Furthermore, this forfeits all the claims against warranty.

The power plug must be inserted in a socket featuring a grounding (earth) contact. The grounding effect must not be made ineffective by an extension cable which does not have a protective ground wire.

If it is established that the protection measures are no longer effective, the instrument must be switched off and safeguarded against inadvertent operation. Please contact your local Carl Zeiss service agency or the Carl Zeiss microscopy service for the repair of the instrument.

The wide range power unit which is integrated in the stand of the microscope permits the use of line voltages in the range between 100 and 240 V AC ± 10%, 50 - 60 Hz, without the need for the voltage to be changed at the instrument.

Always disconnect the instrument from the line before opening the instrument and before changing the fuses.

Make sure to use only fuses of the rated power required. The use of makeshift fuses and the short-circuiting of the fuse holders are not permitted.

The Axiolab A microscope is not equipped with any special devices for protection from substances which are corrosive, toxic, radioactive or otherwise hazardous to health. All the legal regulations for accident prevention, particularly those in the respective countries, must be observed when handling such substances.

Avoid touching the hot lamp housing. Always pull the power plug before changing the lamps and allow the instrument to cool down for approx. 15 mins.

Dust and dirt can impair the performance of the instrument. Therefore, the instrument must be protected against these influences as far as possible, and covered with the dust cover if it is not used for longer periods of time. Always check whether the instrument is switched off before you cover it.

Placing objects against or covering ventilation slats can lead to a build-up of heat which will damage the instrument and, in extreme cases, cause a fire. Always keep the ventilation slats clear and make sure that no objects enter the instrument through the ventilation slats.

The instruments must be operated by trained personnel only who must be aware of the possible danger involved with microscopy and the relevant application. The Axiolab A is an optical precision instrument which can be impaired in its performance or damaged when handled improperly.

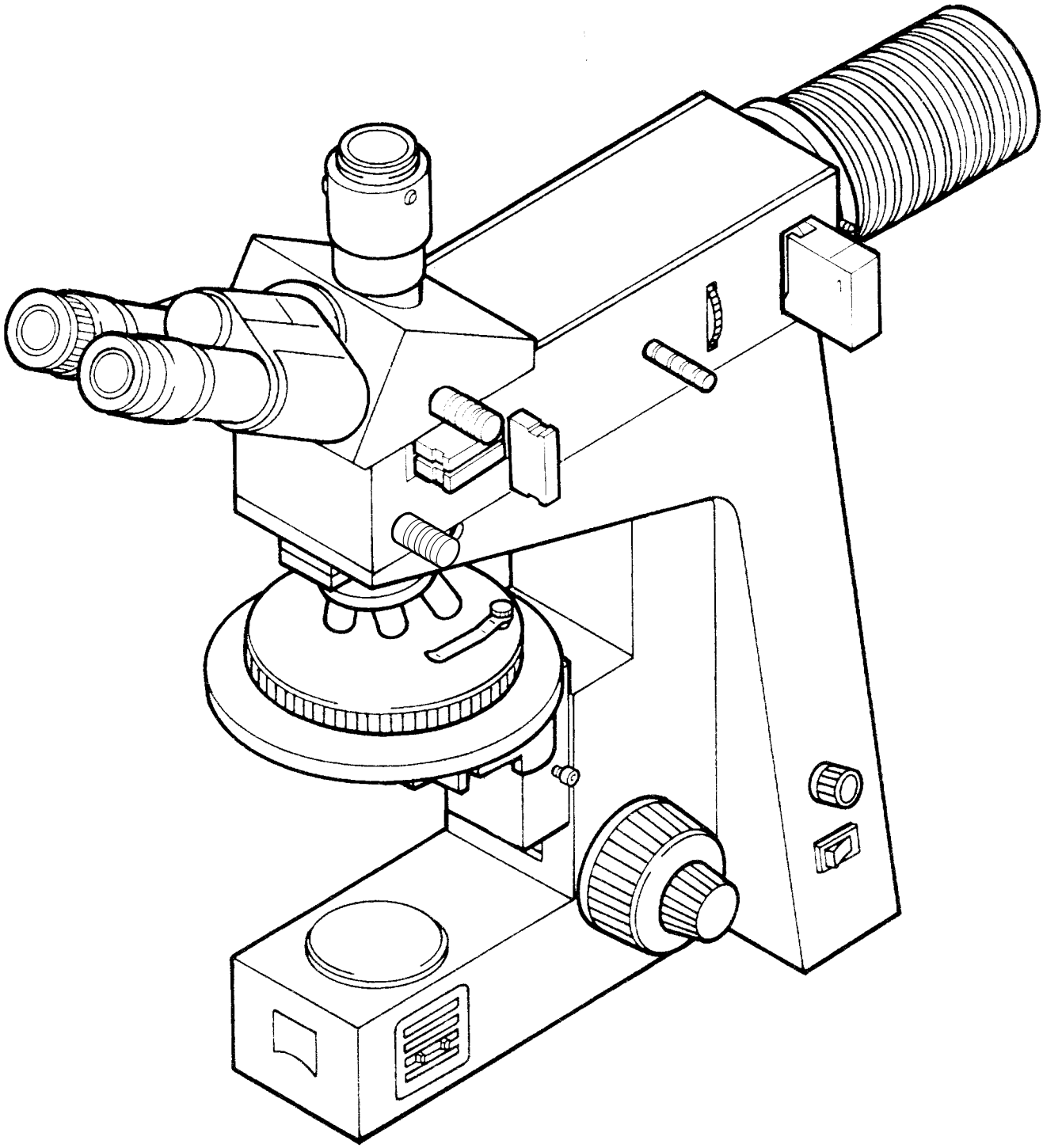
Notes on warranty

The manufacturer guarantees that the instrument has no material and production defects when delivered. You must inform us of any defects immediately and we must do anything to minimize the damage. If the manufacturer is informed of such a defect, he is obliged to remove it; it is his decision whether he does this by repairing the instrument or by delivering an instrument free of any defect. No guarantee is provided for defects caused by natural wear (wearing parts in particular) and improper use.

The instrument manufacturer is not liable for damage caused by faulty operation, negligence or any other meddling with the instrument, particularly the removal or replacement of instrument components, or the use of accessories from other manufacturers. This forfeits all the claims against warranty.

With the exception of the work specified in this manual, no maintenance or repair of the Axiolab A may be performed. Repairs may only be performed by Carl Zeiss service staff or specially authorized personnel. Should any defect occur with the instrument, please get in touch with your local Carl Zeiss agency.

Overall View of the Axiolab A Reflected-Light Microscope



DESCRIPTION

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1 DESCRIPTION

1.1 Name; Intended Application,

Manufacturer's name: Upright reflected-light microscope for routine examinations

Within the product family of upright reflected-light microscopes, the Axiolab A fits in as follows:

- Routine microscopes
  - **Axiolab A**
  - Axiotech / Axiotech vario
  - Axioskop 2 / Axioskop 2 MOT
- Research microscopes
  - Axioplan 2 imaging
  - Axiophot 2
  - Axiotron 2 / Axiotron DUV
  - Axioskop 2 FS / Axioskop 2 FS MOT

The Axiolab A reflected-light microscope is a light microscope suitable for use in all areas of research and industry involving opaque material, e.g. in

- metallography (metallic and compound materials)
- engineering mineralogy (ceramics, building materials, slags and ashes)
- production inspection/receiving inspection (plastics, papers and textiles)

The Axiolab can also be equipped with a transmitted-light facility for the examination of transparent material samples.

1.2 Instrument Description

The Axiolab A microscope is a high-performance routine microscope. Due to its compact design and clearly arranged controls, the instrument also meets high demands on user-friendliness.

- Microscope stand (1-1/**1**): diecast component with low-lying center of gravity and, therefore, high stability.
- Coaxial coarse/fine drive (1-1/**2**): focusing function acting on the specimen stage
- Stage: optionally as fixed version (1-1/**3**), as glide stage (1-1/**5**) or as mechanical stage (1-1/**4**)
- 5-position objective nosepiece (1-1/**6**) with W 0.8 × 1/36" thread
- Reflected-light illuminator H (1-1/**7**) with permanently attached binocular phototube A H (1-1/**8**), two E-PL 10×/20 Br. and E-PL 10×/20 Br. foc. eyepieces , and camera port (1-1/**9**)
- Wide-range power supply in the stand can be set to line voltages between 100 and 240 V AC
- Reflected-light halogen illuminator (1-1/**10**) with 6 V, 30 W halogen lamp

The Axiolab A microscope features a modular design, i.e. standard modules can be easily replaced with alternative modules, or further accessories can be added. The carrier element for this purpose is the microscope stand (1-1/**1**), in which the power supply unit is also integrated. The new wide-range power supply in the stand can be set to line voltages between 100 and 240 V AC by the user himself.

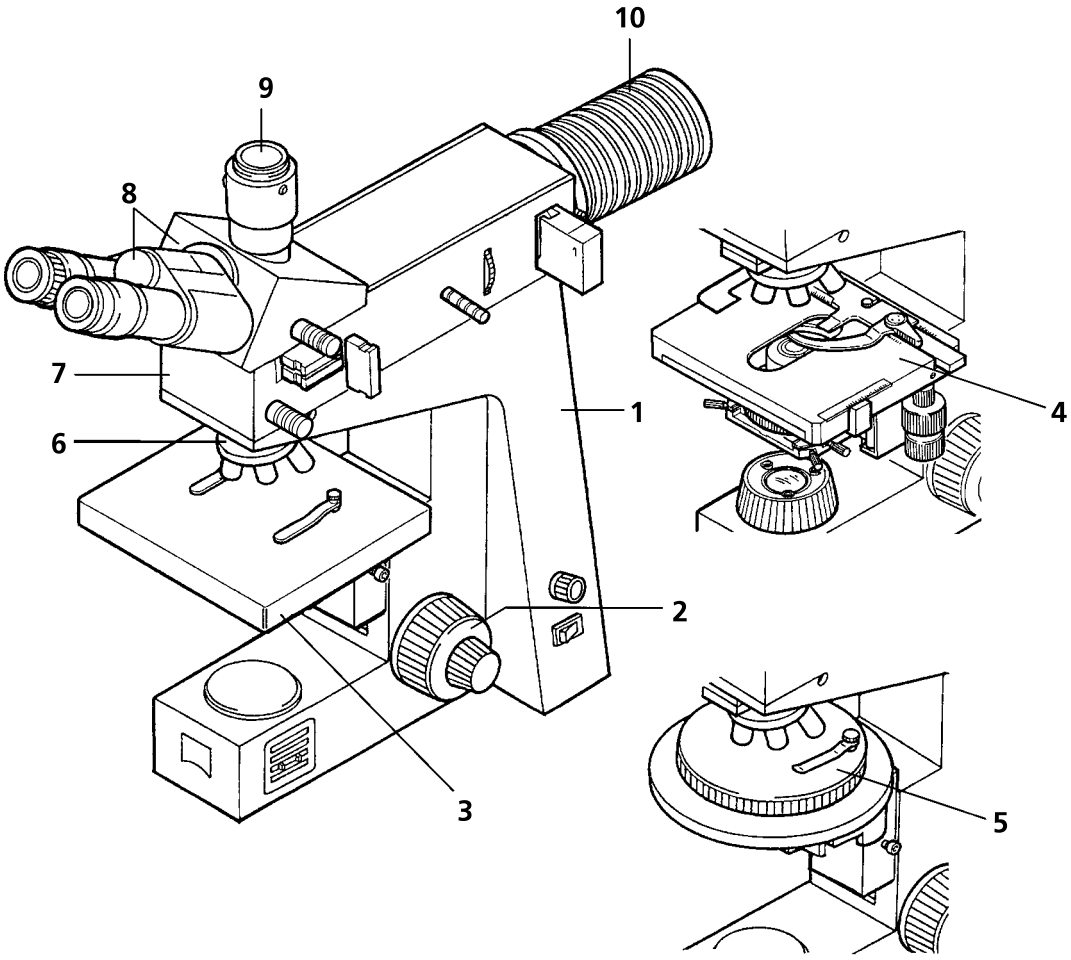


Fig. 1-1 Axiolab A main modules

The specimen stage can be designed

- as fixed stage (1-1/**3**) with stage clamps,
- as glide stage (1-1/**5**) with stage clamps, 25 × 25 mm travel range, or
- as mechanical stage (1-1/**4**) 75 × 35 R/A with ceramic surface and short drive.

Both the fixed stage and the glide stage can be locked in a top or a bottom stop. The maximum specimen height is 45 mm.
The mechanical stage is a component of the transmitted-light version of the Axiolab A and permits the particularly sensitive moving of transparent objects. For opaque specimens, this mechanical stage can be equipped with a special specimen holder, permitting the maximum specimen height of 18 mm. Controls within easy reach and the user-friendly viewing height of 440 mm with a 30° viewing angle ensure fatigue-free work.

The reflected-light halogen illuminator (1-1/**10**) is equipped with a 6V 30 W halogen lamp as a standard. Its luminous intensity (lamp voltage) is continuously variable via the relevant control. The correct color temperature for color photography (3200 K) is automatically reached in the end stop. The XBO 75 or HBO 50 illuminators can also be attached to the Axiolab A for examinations requiring a high illuminance. Other features: adjustable aperture diaphragm and homogeneous illumination of object fields of up to dia. 8 mm.

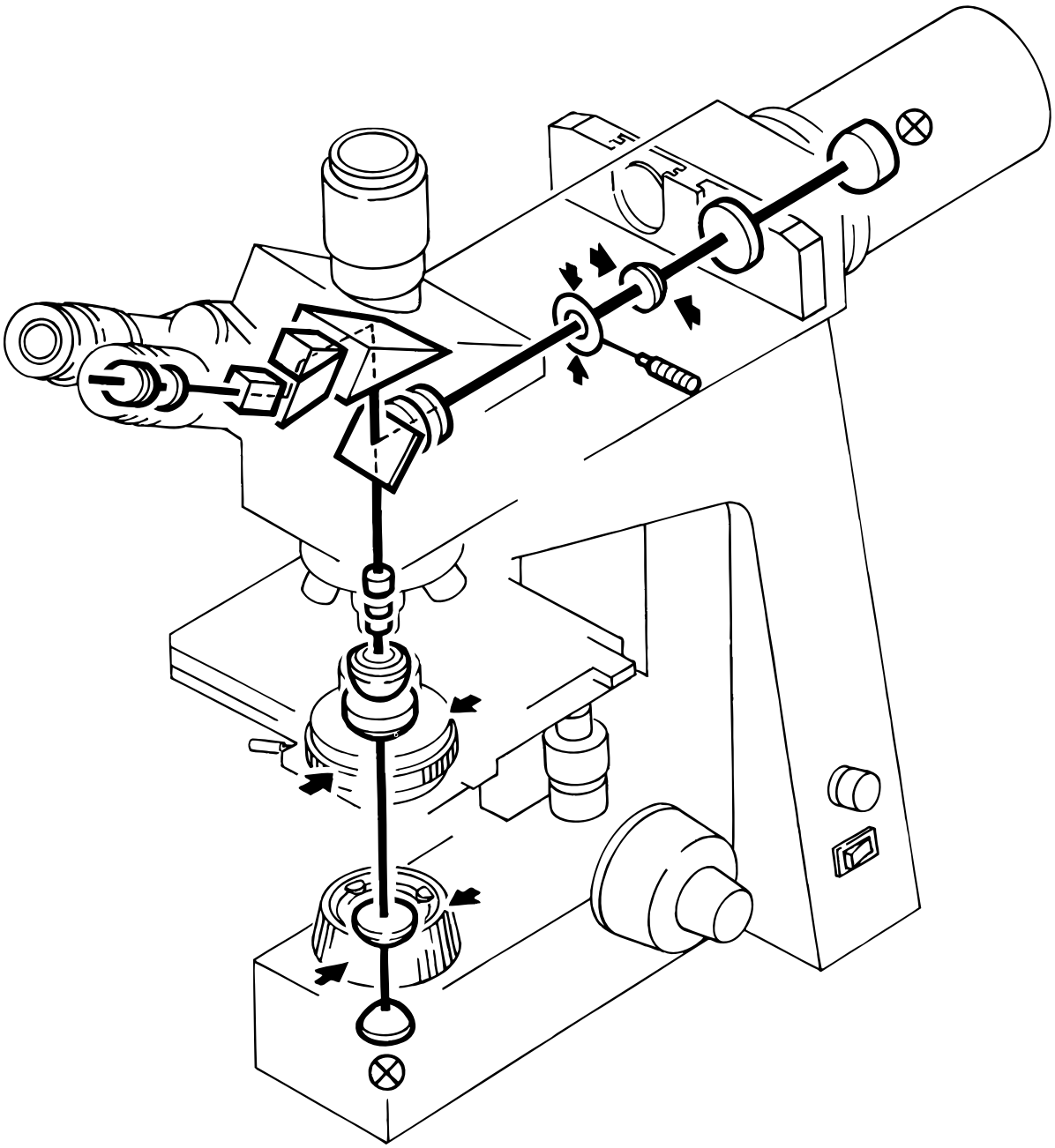


Fig. 1-2 Optical design of the Axiolab A with transmitted-light equipment

The optical performance of the Axiolab A can be ideally matched to the relevant requirements by using various objectives which are inserted into a 5-position nosepiece (1-1/**6**).

The camera port (1-1/**9**) attached to the binocular reflected-light tube (1-1/**8**) is available for the documentation of microscope images. Microscope and video accessories are attached via a wide variety of specific adapter components and modules.

Pulling out or pushing in the pushrod on the binocular tube allows you to switch between observation and photomicrography/videomicroscopy. Switchover is 100% in each case, i.e. simultaneous observation and documentation is not possible.

The use of specific sliders in the reflected-light illuminator H allows observation in polarization contrast. Epi-fluorescence observation is possible with a special fluorescence configuration.

1.3 Microscope Configurations and Modules

Depending on the application, the following configurations of the Axiolab A microscope are recommended:

- Axiolab A for reflected-light brightfield with fixed stage and Epi-objectives
  Cat. No. 490960-9804-000
- Axiolab A for reflected-light brightfield with glide stage and Epi-objectives
  Cat. No. 490962-9804-000
- Axiolab A for reflected-light brightfield and transmitted-light examinations with mechanical stage
  Cat. No. 490961-9804-000

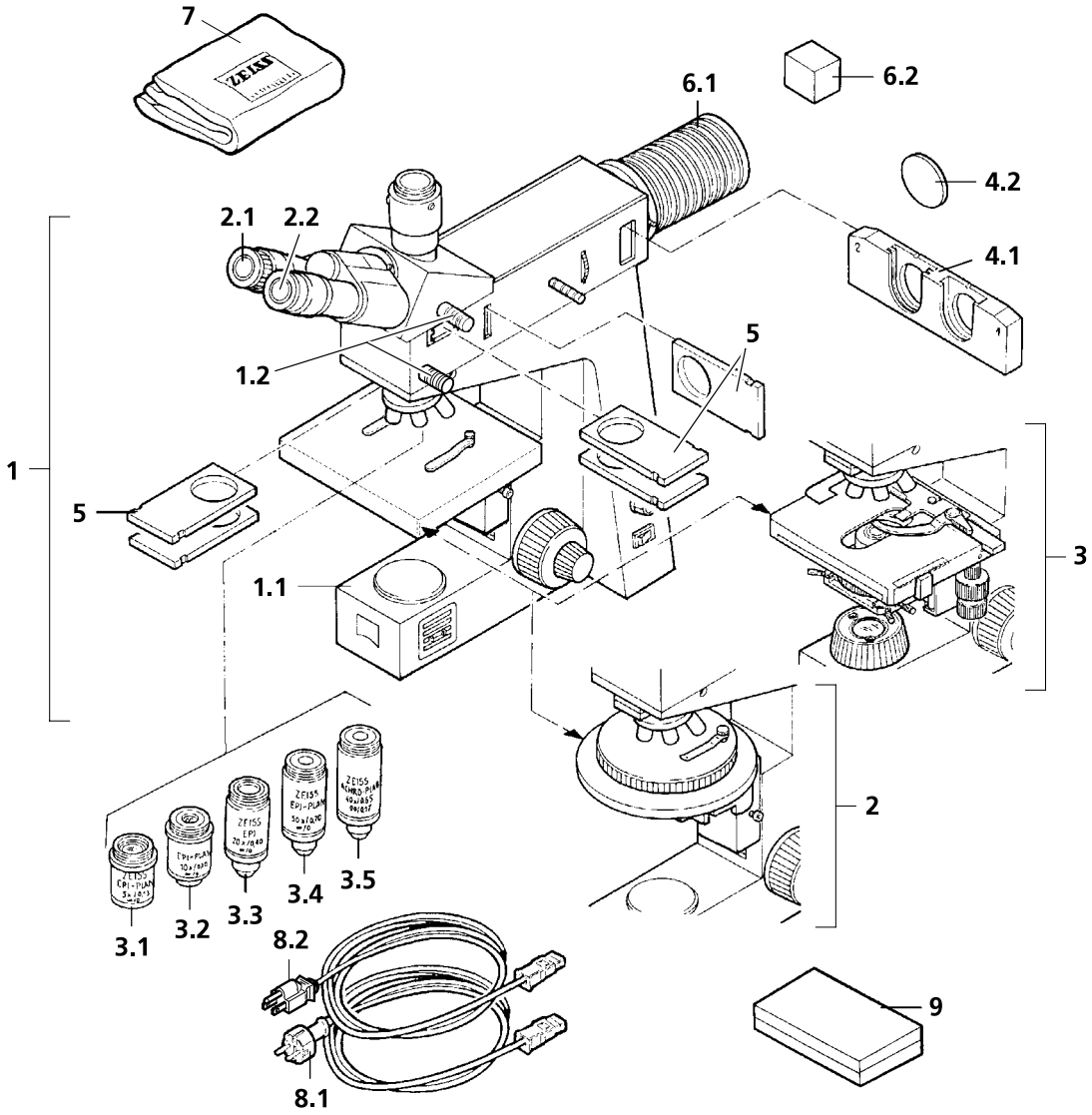


Fig. 1-3 Axiolab A microscope configurations

	Axiolab A microscope configurations	Cat. No.	Fixed stage	Glide stage	Mechani-cal stage
1	**Configurations**				
1	Microscope Axiolab A with fixed mechanical stage	490960-9804-000	•		
2	Microscope Axiolab A with glide stage	490962-9804-000		•	
3	Microscope Axiolab A with mechanical stage and additional transmitted-light equipment	490961-9804-000			•
	Selected modules for configuration 1				
1.1	Microscope stand Axiolab A	450909-0000-000	•		
1.2	Binocular phototube 30°/20 A H (100 vis/ 100 doc) with reflected-light illuminator H	450962-0000-000	•		
2.1	Eyepiece E-PL 10×/20 Br.	444231-9901-000	•	•	•
2.2	Eyepiece E-PL 10×/20 Br. foc.	444232-9902-000	•	•	•
3.1	Epiplan objective 5×/0.13 ∞/-	442920-0000-000	•	•	•
3.2	Epiplan objective 10×/0.20 ∞/-	442930-0000-000	•	•	•
3.3	Epi objective 20×/0.40 ∞/0	442941-0000-000	•	•	•
3.4	Epiplan objective 50×/0.70 ∞/0	442950-0000-000		•	•
3.5	Achroplan objective 40×/0.65 ∞/017	440050-0000-000			•
4.1	Filter slider, is a component of binocular phototube 30°/20 A H (100 vis/100 doc) with reflected-light illuminator H	450962-0000-000	•	•	•
4.2	Attenuation filter 0.06, dia. 32	467848-9001-000	•	•	•
5	Dust cover slider (5 pcs.)		•	•	•
6.1	6 V, 30 W halogen illuminator	447206-9901-000	•	•	•
6.2	6 V, 30 W halogen lamp	000000-0402-943	•	•	•
7	Dust cover G	459306-0000-000	•	•	•
8.1	Mains cable with European plug		•	•	•
8.2	Mains cable with American flat plug		on request	on request	on request
8.3	Fuse insert T 0.8 A; 250 V; 5 × 20 mm (not shown)	000000-0127-019	•	•	•
9	Accessory case		•	•	•

• Part of the microscope configuration

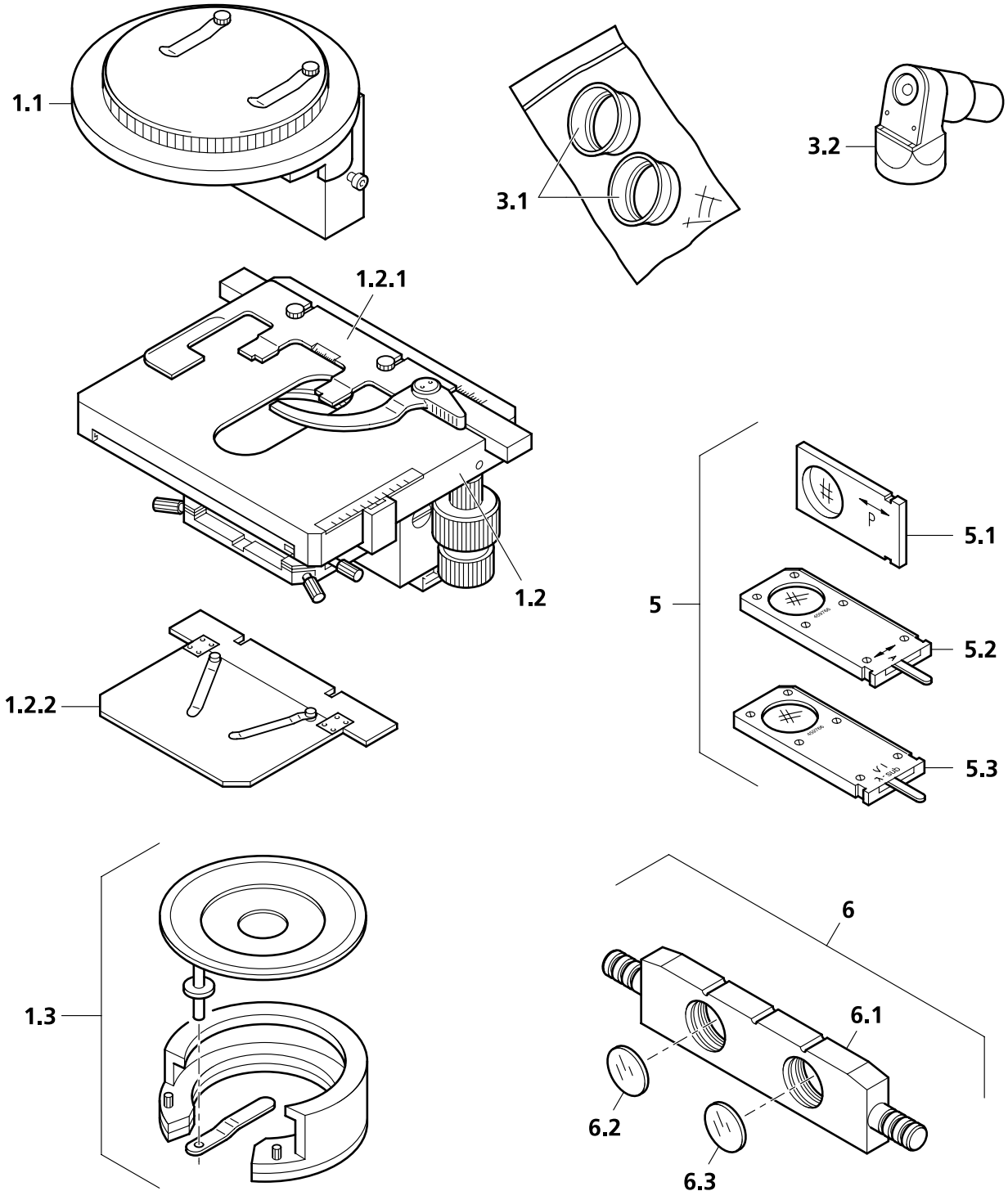


Fig. 1-4 Axiolab A accessories (1 of 2)

	Axiolab A accessories	Cat. No.	Fixed stage	Glide stage	Mechani-cal stage
	STAGES				
1.1	Glide stage with stage carrier	453509-0000-000	◆		
1.2	Mechanical stage 75 × 35 R/A with ceramic surface and short drive, plus:	453517-9901-000	+	+	
1.2.1	Specimen holder with spring clip R	473448-0000-000	+	+	
1.2.2	Specimen holder A	433411-0000-000	+	+	
1.3	Polished specimen attachment	453575-0000-000	◆	◆	
	OBJECTIVES				
2.1	Epiplan objective 100×/0.75 ∞/0	442980-0000-000			◆
2.2	Epiplan-Neofluar objective 2.5×/0.075 ∞/-, plus:	442310-0000-000	◆	◆	◆
2.2.1	2,5× Antiflex cap	444922-0000-000	+	+	+
2.3	Epiplan-Neofluar objective 5×/0.15 ∞/-	442320-0000-000	◆	◆	◆
2.4	Epiplan-Neofluar objective 10×/0.30 ∞/0	442330-0000-000	◆	◆	◆
2.5	Epiplan-Neofluar objective 20×/0.50 ∞/0	442340-0000-000	◆	◆	◆
2.6	Epiplan-Neofluar objective 50×/0.85 ∞/0 for covered specimens:	442350-0000-000		◆	◆
2.7	Achroplan objective 20×/0.45 ∞/0.17	440040-0000-000			◆
2.8	Achroplan objective 40×/0.65 ∞/0.17	440050-0000-000			◆
2.9	Achroplan objective 100×/1.25 ∞/0.17 oil plus:	440080-0000-000			◆
2.9.1	518 N immersion oil, 20 ml oiler	444950-0000-000			+
3.1	Eyecup, folding	444801-0000-000	◆	◆	◆
3.2	8× drawing eyepiece	444128-0000-000	◆	◆	◆
4	Stage micrometer for incident light 5+100/100y D = 0	474027-0000-000	◆	◆	◆
5	Equipment for qualitative polarization in incident light		◆	◆	◆
5.1	Polarizer slider P	453608-0000-000	+	+	+
5.2	Analyzer slider A, rotary	453686-0000-000	+	+	+
5.3	Compensator slider λ-sub	453706-0000-000	+	+	+
6	Equipment for Epodye fluorescence		◆	◆	◆
6.1	Filter slider FL (for dia. 25 filters)	446478-0000-000	+	+	+
6.2	Excitation filter BP 450 ... 490, dia. 25	447722-0000-000	+	+	+
6.3	Barrier filter LP 520, ∅ 25	447737-0000-000	+	+	+

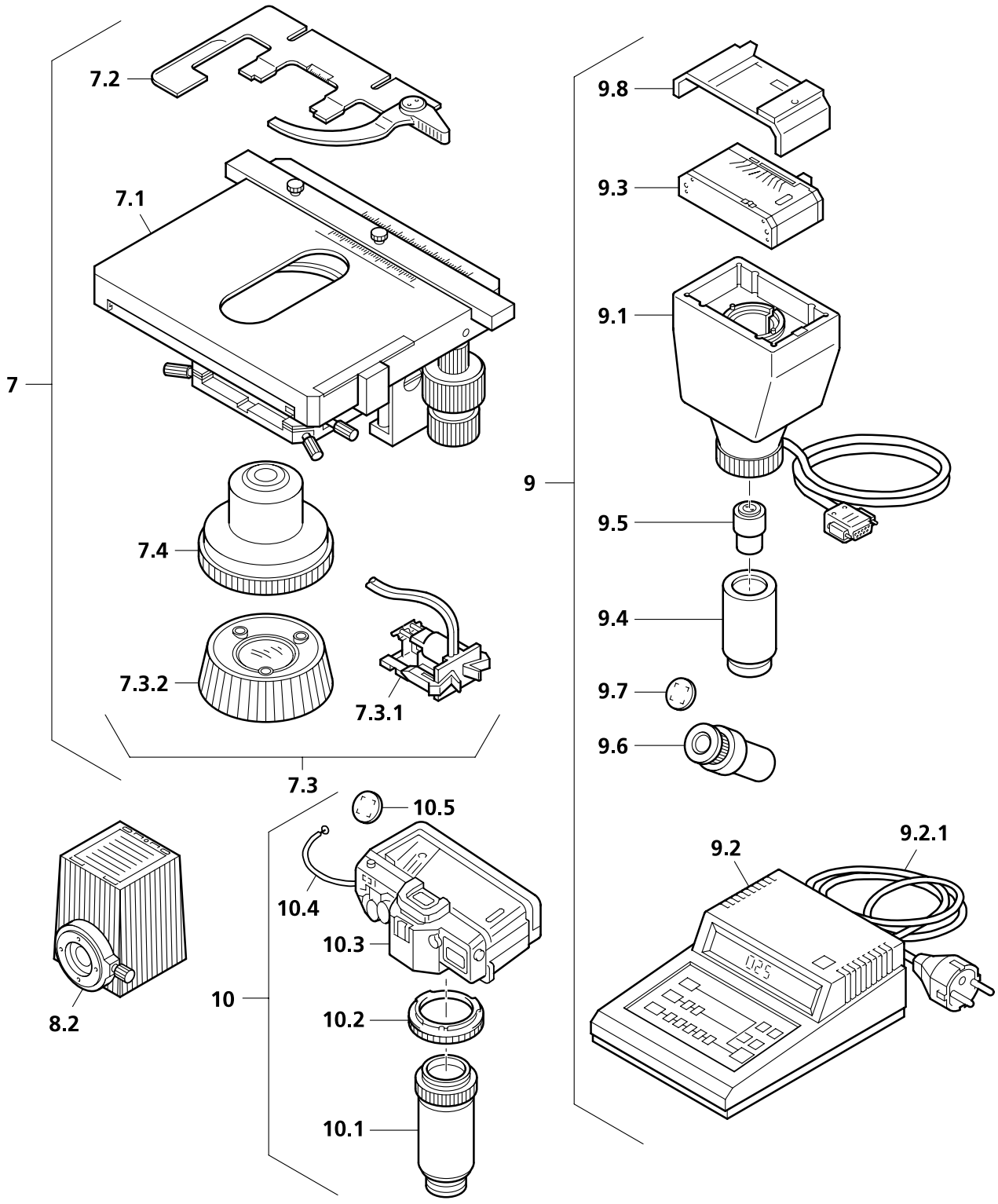


Fig. 1-4 Axiolab A accessories (2 of 2)

	Axiolab A accessories	Cat. No.	Fixed stage	Glide stage	Mechani-cal stage
7	Retrofit package for transmitted-light illumination (can only be fitted by service personnel), consisting of:		◆	◆	
7.1	- Mechanical stage 75 × 35 R/A with ceramic surface	453517-9901-000	+	+	
7.2	- Specimen holder (1) with spring clip R	473448-0000-000	+	+	
7.3	- Transmitted-light illumination, consisting of:	450951-0000-000	+	+	
7.3.1	- 6 V, 30 W halogen lamp	000000-0402-943	+	+	◆
7.3.2	- Luminous-field diaphragm with iris		+	+	+
7.4	- ABBE condenser 0.9/1.25	445302-0000-000	+	+	+
	For enhanced incident light intensity requirements				
8.1	XBO 75 (Xenon) illuminator	487202-9804-000	◆	◆	◆
8.2	HBO 50 (Hg, 230 V) illuminator	487201-9804-000	◆	◆	◆
	HBO 50 (Hg, 115 V) illuminator	487201-9904-000			
9	MC 80 DX microscope camera for 24 × 36 mm, consisting of:	496065-9804-000	◆	◆	◆
9.1	MC 80 DX basic body	456031-0000-000	+	+	+
9.2	MC 80 DX control panel, plus:	456048-0000-000	+	+	+
9.2.1	Mains cable with European plug	380137-6750-000	+	+	+
9.3	35 mm Mot DX film cassette	456071-0000-000	+	+	+
9.4	Adapter 60 for microscope camera, d = 30mm	456006-0000-000	+	+	+
9.5	Projection lens P 2.5× for MC 80/MC 80 DX	456021-0000-000	+	+	+
9.6	Eyepiece E-PL 10×/20 Br. foc.	444232-9902-000	+	+	+
9.7	Photo reticle MC 2.5×/d = 26 mm	454075-0000-000	+	+	+
9.8	Databack D4 (for 35 mm Mot DX film cassette)	456073-0000-000	+	+	+
10	35-mm SLR camera CONTAX 167 MT, consisting of:				
10.1	T2 2.5× SLR camera adapter	456005-0000-000	+	+	+
10.2	T2 adapter for CONTAX (CONTAX bayonet)	416010-0000-000	+	+	+
10.3	SLR-camera housing CONTAX 167 MT	416181-0000-000	+	+	+
10.4	Cable release	416167-0000-000	+	+	+
10.5	Photo reticle MC 2.5×/d = 26 mm	454075-0000-000	+	+	+
11.1	Other T2 adapters (not shown) T2-Adapter for OLYMPUS OM (OM bayonet)	416002-0000-000	+	+	+
11.2	T2-Adapter for MINOLTA (SR bayonet)	416003-0000-000	+	+	+
11.3	T2-Adapter for CANON (FD bayonet)	416004-0000-000	+	+	+
11.4	T2-Adapter for NIKON F (F bayonet)	416009-0000-000	+	+	+
11.5	T2-Adapter for PENTAX (KA bayonet)	416011-0000-000	+	+	+

◆ unit operable in combination with microscope equipment
\+ functions in combination with a further accessory unit

1.4 Function Elements (see Fig. 1-5, after this table)

Item	Designation	Purpose/description
1	Stand	Module base of the Axiolab A microscope
2	6 V, 30 W reflected-light halogen illuminator	Reflected-light illuminator with 6 V, 30 W halogen lamp
3	Reflected-light illuminator H	Carrier element for the binocular tube and the illuminator; also used to accommodate various technique sliders
4	Camera port	Enables (after removal of the dust cap) the connection of various adapters for attachment of photomicrography/videomicroscopy equipment (35 mm cameras, video cameras)
5	Binocular tube	Binocular viewing tube permanently attached to the reflected-light illuminator H; can be set to the user's individual interpupillary distance; after removal of the dust caps, dia. 30 mm eyepieces - one of which is adjustable (foc) - can be inserted.
6, 7	Eyepiece, right and left	Fixed and adjustable (foc) eyepiece; the fixed eyepiece must be assigned to the less myopic eye; two focusing eyepieces are required if reticles or photo reticles are used.
8	Dust protection slider (2 pcs.)	These two dust protection sliders should always remain in the Axiolab A microscope; technique sliders can also be inserted only if transmitted-light equipment is available
9	Objective nosepiece	Carrier for the maximum of 5 objectives which are swung into the beam path manually
10	Specimen stage, fixed	Stage area: 160 × 140 mm; for the maximum specimen height of - 20 mm (stage attached at upper stop) or - 45 mm (stage attached at lower stop) Two spring clips (supplied) enable specimens attached to a 26 × 76 mm slide to be held in position (also see item 31)
11	Coaxial coarse and fine drive, L	Permits the specimen stage to be lifted and lowered within a travel range of approx. 20 mm (also see section 1. 6 (7)); used for specimen focusing; mechanical unit together with item 29
12	Connecting cable for 6 V 30 W reflected-light illuminator	Must be connected to the sockets at the instrument rear to allow operation of the reflected-light illuminator
13	"A/D" illumination converter	Permits the switchover between incident light and transmitted-light when instruments with an additional transmitted-light equipment are used.

Item	Designation	Purpose/description
14	Fuse holder	Holder for two fuse inserts
15	Fuse insert	T 0.8 A; 250 V; 5 × 20 mm
17	Mains cable	To apply the supply voltage
18	Pushrod	Pushrod to change the beam path between - observation through the binocular tube (pushrod pushed in) - photomicrography/videomicroscopy through camera port (pushrod pulled out)
19	Aperture diaphragm	Used to limit the illumination aperture; can be changed via knurled wheel
20	Filter slider	Permits the insertion of dia. 32 filters in the illumination beam path; can be equipped, for example, with - attenuation filter D = 0.06
21	Pushrod for luminous-field diaphragm (incident light)	Permits insertion of a perforated plate with 1/3 field size
22	Dust protection slider	Prevents the entry of dust. Can be replaced during operation with the polarization slider P (item 23)
23	Polarization slider P	Permits observation of the specimen in polarized light (EAST-WEST oscillation direction)
24	Dust protection slider (2 pcs.)	Prevents the entry of dust. Can be replaced during operation with the analyzer slider A and the λ-sub compensator slider
25	Analyzer slider A, rotary	Enables polarization contrast in combination with the polarizer slider P (NORTH-SOUTH oscillation direction with ±10° fine adjustment possibility)
26	Compensator slider λ-sub	In combination with the polarizer and analyzer slider, this slider permits the color contrast of anisotropic specimen details

Item	Designation	Purpose/description
27	"Luminous intensity" control	Continuous control of the illuminance of the light source by changing the lamp voltage in the range from > 1.5...6 V. At 6 V (right stop) the 3200 K color temperature for color photography is reached.
28	On/off switch with mains pilot lamp	Main instrument switch to switch the line voltage on and off
29	Coaxial coarse and fine drive, R	Permits the specimen stage to be lifted and lowered within a travel range of approx. 20 mm (also see section 1. 6 (7)); used for specimen focusing; mechanical unit together with item 11
30	Ventilation grille	For ventilation of the transmitted-light illuminator, if contained in the instrument configuration
31	Glide stage	The glide stage features a manually adjustable stage plate with a travel range of 25 × 25 mm. The max. specimen height corresponds to that of the fixed stage. Two supplied spring clips enable objects on a 26 × 76 mm slide to be held in position. Objects can also be held in position by the so-called polished specimen stage (accessory), with which unilaterally polished specimens can be aligned plane-parallel with the stage surface.
32	Condenser drive *)	To focus the condenser in the work position
33	Specimen holder with spring clip R *)	To mount and guide transmitted-light specimens
34	Specimen holder A	To mount and guide opaque objects or specimens
35	Condenser *)	Brightfield condenser 0.9/1.25 or other condenser included in the list
36	Luminous-field diaphragm *) (transmitted-light)	Adjustable iris diaphragm to change the field size in transmitted-light
37	Clamping screw *)	To clamp the condenser
38	Centering screw *)	To center the image of the luminous-field diaphragm
39	Mechanical stage 75 × 35 R/A *)	Sensitive mechanical stage with ceramic surface, short drive, and a travel range of 75 × 35 mm
40	Pushrod	Pushrod to change the beam path between reflected-light and transmitted-light observation; - pushrod pulled out reflected-light observation - pushrod pushed in transmitted-light observation
*) Part of the transmitted-light configuration		

1 Stand
2 6 V, 30 W halogen illuminator
3 Reflected-light illuminator H
4 Camera port
5 Binocular tube
6 Eyepiece, fixed
7 Focusing eyepiece
8 Dust protection slider
9 5-position objective nosepiece
10 Specimen stage, fixed
11 Coaxial coarse and fine drive (left, also see item 29)
12 Connecting cable for halogen illuminator
13 "A/D" illumination converter
14 Fuse holder
15 Fuse inserts (T 0.8 A; 250 V; 5 × 20 mm)
17 Mains cable
18 Pushrod to change beam path
19 Aperture diaphragm
20 Filter slider
21 Pushrod (for luminous-field diaphragm)
22 dust protection slider
23 Polarizer slider P
24 Dust protection slider
25 Analyzer slider A, rotary
26 λ-sub compensator slider
27 "Light intensity" control
28 ON/of switch with mains pilot lamp
29 Coaxial coarse and fine drive (right, also see item 11)
30 Ventilation grille
31 Glide stage
32 Condenser drive
33 Specimen holder with spring clip R
34 Specimen holder A
35 Condenser
36 Luminous-field diaphragm (transmitted-light)
37 Clamping screw
38 Centering screw
39 Mechanical stage
40 Pushrod to change between reflected-light or transmitted-light observation

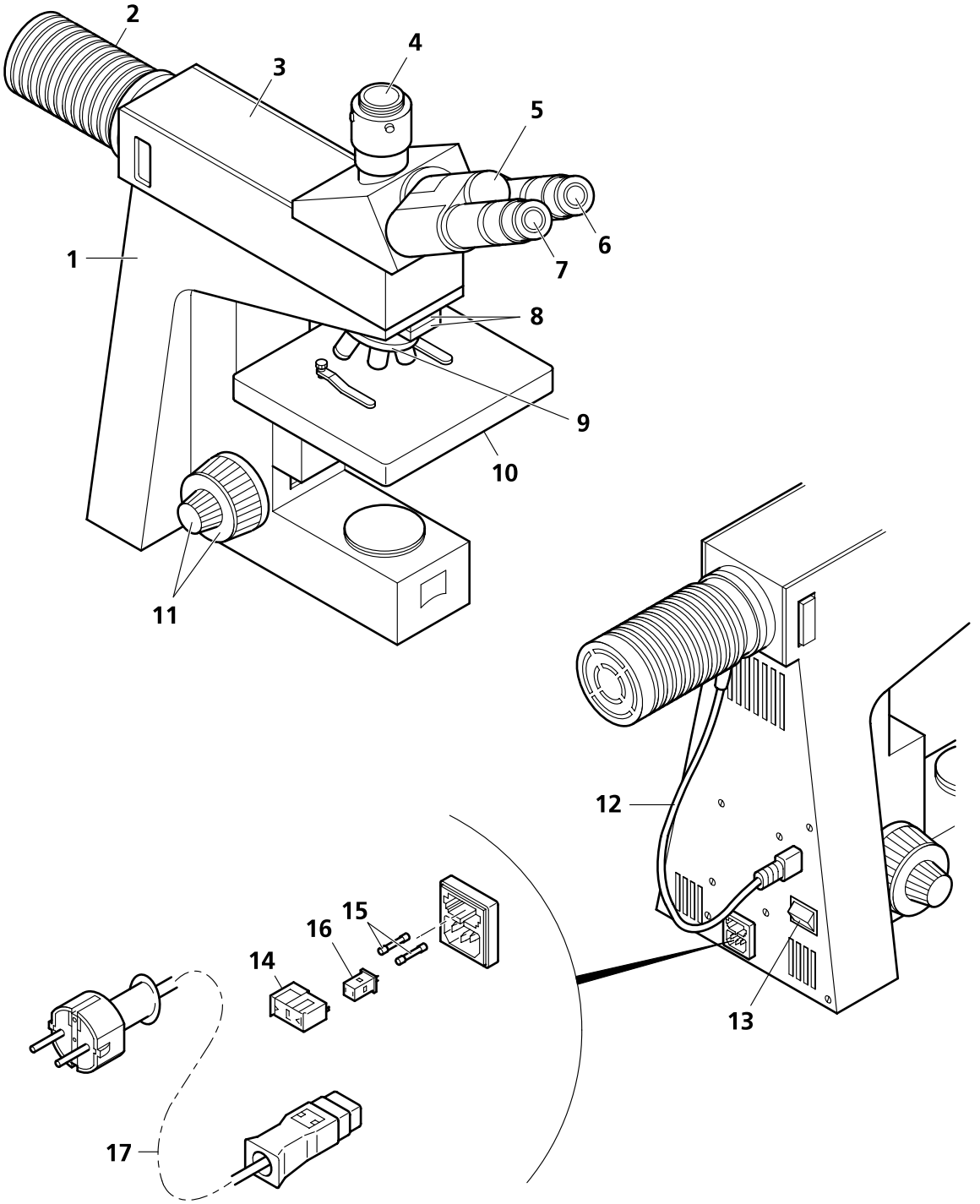


Fig. 1-5 Axiolab A function elements (1 of 2)

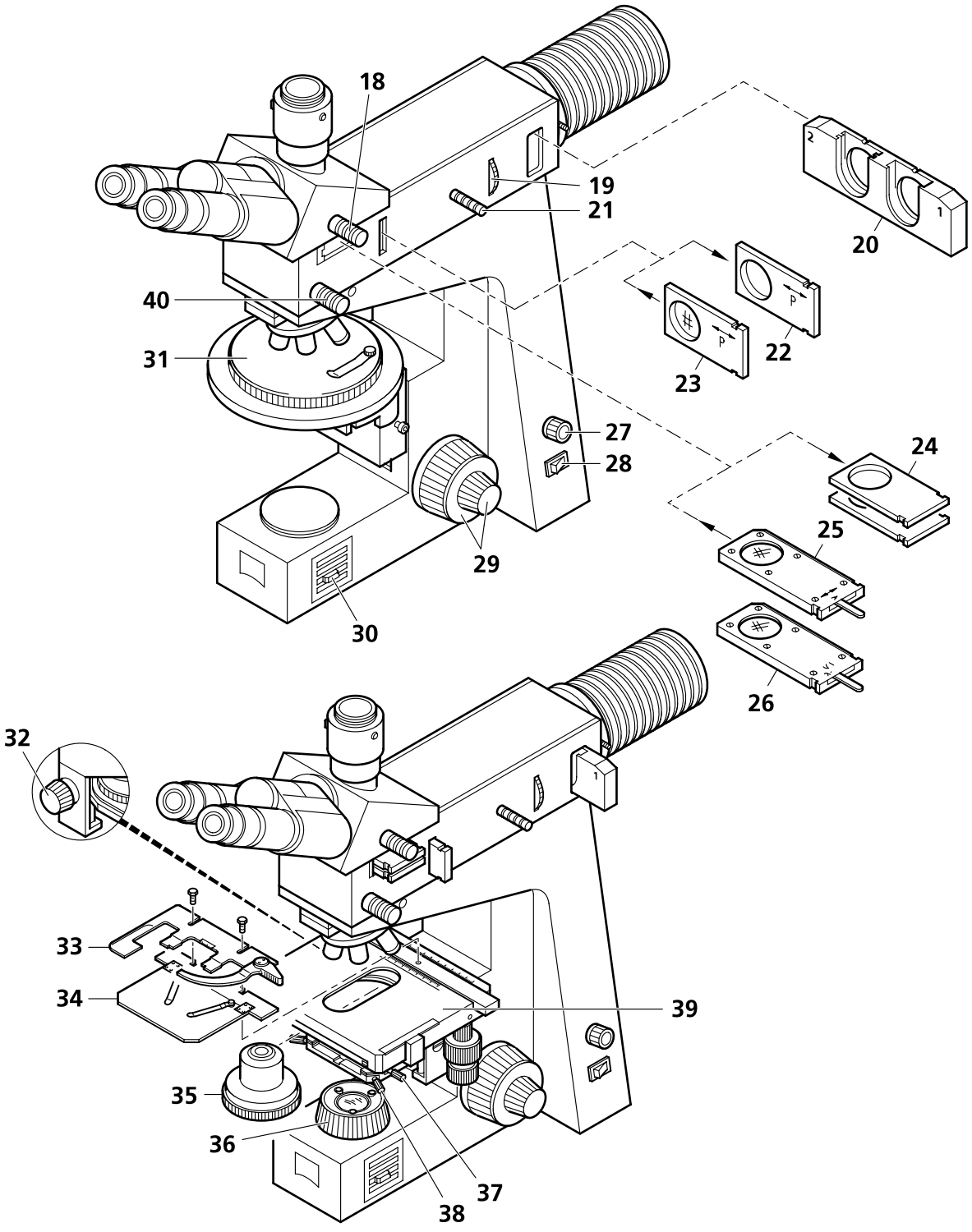


Fig. 1-5 Axiolab A function elements (2 of 2)

1.5 Objectives

The objectives are the optical centerpiece of the microscope. The following is an example of how objectives can be labelled:

Epiplan 10×/0.20 ∞/-

where

10× : objective magnification, with a defined color ring on the objective being allocated to each magnification step (Carl Zeiss color ring code)

0.20 : numerical aperture

∞ : infinite tube length

- : can be used with cover slip thickness D = 0 or 0.17 mm

or

0 : can only be used without cover slip, that means D = 0

0.17 : can be used with cover slip thickness D = 0.17 mm

and

Oil : oil immersion objective

Ph 2 : phase contrast objective with a green color ring and phase stop Ph 2

Color ring code for objective magnification

Color ring on objective	black	brown	red	orange	yellow	green	light blue	dark blue	white
Magnification factor	1.25×	2.5×	4×; 5×	6.3×	10×	16×;20×; 25×;32×	40×; 50×	63×	100×; 150×

The objective magnification multiplied with the eyepiece magnification (usually 10×) results in the visual overall magnification: e.g. 10 × 10 = 100×.

The numerical aperture × 1000, e.g. 0.20 × 1000 = 200×, is the highest useful magnification, i.e. no further details are resolved above that limit.

In transmitted-light applications, the exact observance of the cover slip thickness of 0.17 mm is all the more necessary the higher the numeric aperture of the objective. Therefore, so-called "Korr" objectives can be set for different cover slip thicknesses via a correction ring. For this, a specimen area is searched, and the position of the correction ring where optimum focus and image contrast are obtained is determined (refocusing is always required).

Immersion objectives are always insensitive to differences in cover slip thickness.

When immersion objectives are used, the air between the cover slip and the objective is replaced with a liquid, which is immersion oil in most cases. The plastic oiler containing 20 ml of 581 N immersion oil is particularly suitable for this purpose.

The following objectives are available for the Axiolab A:

Microscopy technique	Objective	Magnification/ Num. Aperture	Free working distance in mm	Cover slip thickness D in mm	Cat. No.
Reflected-light brightfield	**Epiplan**				
	Epiplan	5×/0.13	19.8	-	442920-0000-000
	Epiplan	10×/0.20	18.4	-	442930-0000-000
	Epiplan	20×/0.40	0.6	0	442941-0000-000
	Epiplan	50×/0.70	0.95	0	442950-0000-000
	Epiplan	100×/0.75	0.95	0	442980-0000-000
Reflected-light brightfield	**Epiplan-Neofluar**				
	Epiplan-Neofluar	2.5×/0.075	9.4	-	442310-0000-000
	Epiplan-Neofluar	5×/0.15	13.7	-	442320-0000-000
	Epiplan-Neofluar	10×/0.30	5.7	0	442330-0000-000
	Epiplan-Neofluar	20×/0.50	1.4	0	442340-0000-000
	Epiplan-Neofluar	50×/0.80	0.58	0	442350-0000-000
Transmitted-light brightfield	**Achroplan**				
	Achroplan	20×/0.45	2.07	0.17	440040-0000-000
	Achroplan	40×/0.65	0.59	0.17	440050-0000-000
	Achroplan	50×/0.90 Oil	0.29	0.17	440057-0000-000
	Achroplan	63×/0.80	0.29	0.17	440060-0000-000
	Achroplan	63×/0.95	0.15	0	440068-0000-000
	Achroplan	100×/1.25 Oil	0.19	0.17	440080-0000-000
	Achroplan	100×/1.25 Oil Iris	0.19	0.17	440086-0000-000

1.6 Eyepieces

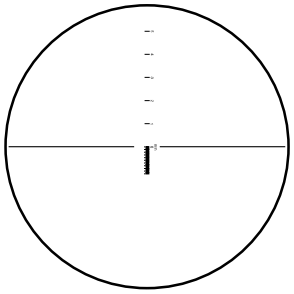
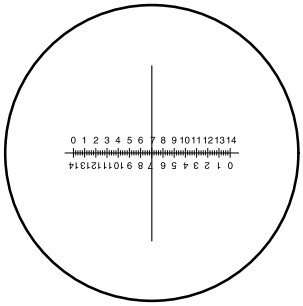
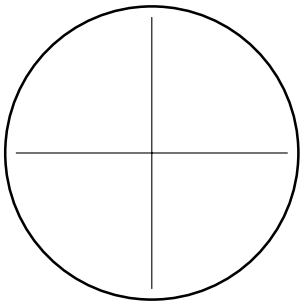
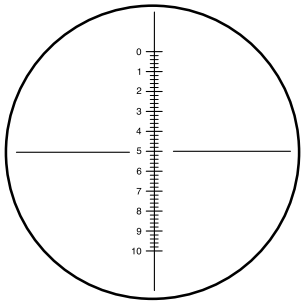
The following eyepieces are available for the Axiolab A:

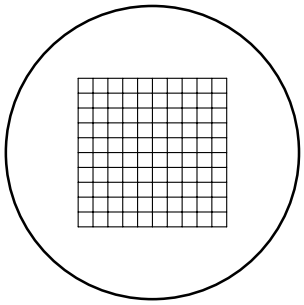
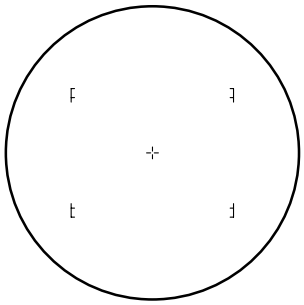
Eyepiece	Image angle	Cat. No.
Eyepiece E-PL 10×/20 Br.	43°	444231-9901-000
Eyepiece E-PL 10×/20 Br. foc.	43°	444232-9902-000
Eyepiece PL 16×/16 Br.	54°	444053-0000-000
Eyepiece PL 16×/16 Br. foc.	54°	444054-0000-000

If required, eyecups for the eyepieces can be ordered under Cat. No. 444801-0000-000.

1.7 Stage Micrometers and Eyepiece Reticles

Measuring and counting using the microscope requires stage micrometers and eyepiece reticles, a small selection of which is listed below:

Illustration	Description, Technical data	Cat. No.
	**stage micrometer, positive 5 + 100/100 y** D = 0.17 mm gradation on the +y-axis: 5 mm in 5 intervals gradation on the -y-axis: 1 mm in 100/100 mm = 10 µm, accuracy ±1µm	474026-0000-000
	**crossline micrometer 14 : 140 / d = 26 mm** gradation length = 14 mm increments = 0.1 mm gradation tolerance ≤ 0.001 mm	454060-0000-000
	**eyepiece reticle / d = 26 mm**	474064-0000-000
	**crossline micrometer 10 : 100 / d = 26 mm** gradation length = 10 mm increments = 0.1 mm gradation tolerance ≤ 0.001 mm	474066-9901-000

	**net micrometer 12.5 × 12.5 / 5 ; 10, d = 26 mm** area 12.5 × 12.5 mm, divided in fields of 10 × 10	474068-0000-000
	**photo reticle MC 2.5× / d = 26 mm** for 35 mm photography with an additional magnification of 2.5× or for large-format photography with 10× additional magnification.	454075-0000-000

☞ If an eyepiece reticle is used, the binocular tube or the phototube must be equipped with two foc. eyepieces containing an adjustable eyelens, into one of which the eyepiece reticle is mounted.

1.8 Technical Data

Dimensions and weight

Dimensions (width × depth × height) ..... 180 × 400 × 430 mm
Footprint (recommended with mat) ..... 440 × 310 mm
Weight ..... approx. 10 kg

Ambient conditions for storage and transport (in packaging)

Permissible ambient temperature ..... -40 to +50 °C
Permissible relative humidity ..... max. 85 %
Atmospheric pressure ..... 800 hPa to 1060 hPa

Operation

Permissible ambient temperature ..... +5 to +40 °C
Permissible relative humidity ..... max. 85 %
Altitude ..... max. 2000 m
Atmospheric pressure ..... 800 hPa to 1060 hPa
Pollution degree 2

Operating data

Category of use ..... closed rooms
Protection class I
Protection type ..... IP 20
Electrical safety ..... in compliance with DIN EN 61010 (IEC 1010-1) including CSA and UL directives
Excess voltage category II
Radio interference suppression ..... in accordance with EN 55011, Class B
Insensitivity to noise ..... in accordance with EN 50082
Line voltage ..... 100 to 240 V AC ±10 %
..... Change of line voltage is not required!
Line frequency ..... 50 to 60 Hz
Power consumption ..... max. 80 VA

Fuses

for all line voltages above mentioned ..... T 0.8 A; 250 V; 5 × 20 mm

Mechanical data of specimen stages

Stage models ..... fixed stage/glide stage/mechanical stage
Maximum specimen height:
stage at bottom stop (not possible for mechanical stage) ..... 45 mm
stage at top stop ..... 20 mm

Light source

6 V, 30 W halogen illuminator:
halogen lamp with square flat-core filament ..... HLW S 5-A, 6 V, 30 W
lamp voltage (variable) ..... >1.5 V to max. 6 V
power ..... 30 W
color temperature at end stop ..... 3200 K
light flux at 6 V ..... 510 lm
average life at 6 V/4.8 V ..... 300 h/2000 h
illuminated area ..... 1.7 × 1.7 mm

Opto-mechanical data

Stage focusing ..... coaxial coarse/fine drive
lifting range: 20 mm
coarse drive: 1 rotation = 4 mm
fine drive: 1:10 step-down ratio
Objective change ..... manually via 5-position nosepiece
Maximum field of view ..... 20 mm
Maximum object field ..... 8 mm

Binocular 30°/20 H reflected-light tube with camera/TV port:
maximum field number 20
interpupillary distance ..... variable between 55 and 75 mm
viewing angle ..... 30°
viewing height ..... 440 mm
observation and camera/video port ..... tube factor 1×
observation and camera/video port ..... 100%/0% or 0%/100%
camera/video port ..... 60 mm interface

Eyepieces ..... E-PL 10×/20 Br. and E-PL 10×/20 Br. foc.
plug-in diameter ..... 30 mm

START-UP

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2 START-UP

The three versions of the Axiolab A reflected-light microscope, including accessories, are supplied in standard packaging. We would recommend you to keep the transport cases for storage or return of the instrument to the manufacturer.

2.1 Unpacking the Instrument

- Remove the microscope from the transport case and place it on the mat (2-1/**1**) provided on the worktable.
- Remove the plastic sleeve (2-1/**4**) from the instrument.
- Remove the adhesive strips which secure the various controls during transport.
- Leave dust protection and technique sliders (2-1/**2**, **5**, **6**) inserted in the reflected-light illuminator H (2-1/**3**) in the instrument.

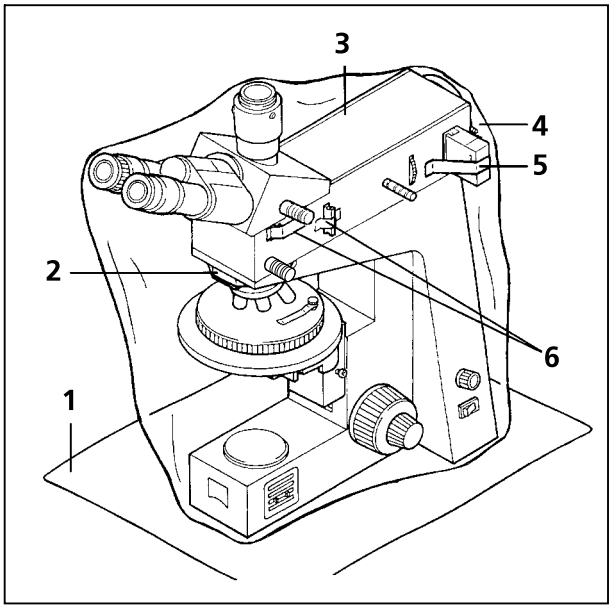

Fig. 2-1 Unpacking the instrument

2.2 Screw in Objectives

- Remove the dust caps (2-2/**2**) according to the number of objectives and screw the objectives into the nosepiece (2-2/**1**) clockwise one by one, starting with the lowest magnification (2-2/**3**).

☞ The dust caps should remain on those nosepiece eyes which are not required.

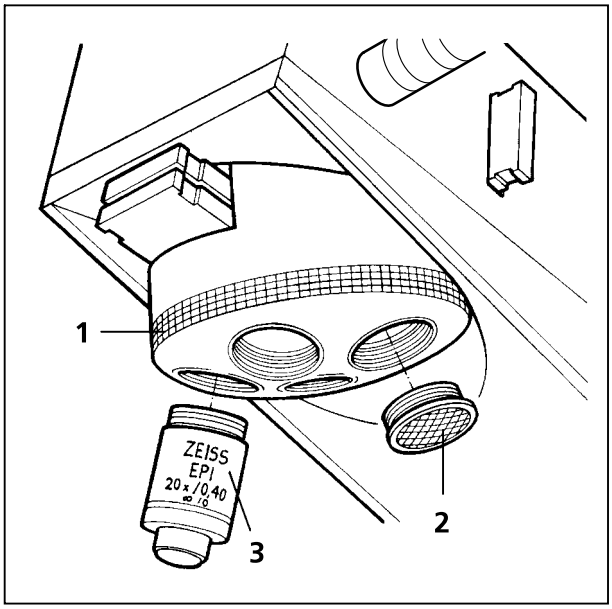

Fig. 2-2 Screw in objectives

2.3 Insertion of Eyepieces

- Remove both protection caps from the binocular tube.
- Insert the fixed eyepiece, e.g. E-PL 10×/20 Br., in one tube and the focusing eyepiece E-PL 10×/20 Br. foc. in the other tube.

☞ The focusing eyepiece is used to compensate for ametropia of the user's eyes.

2.3.1 Insertion of Eyepiece Reticle

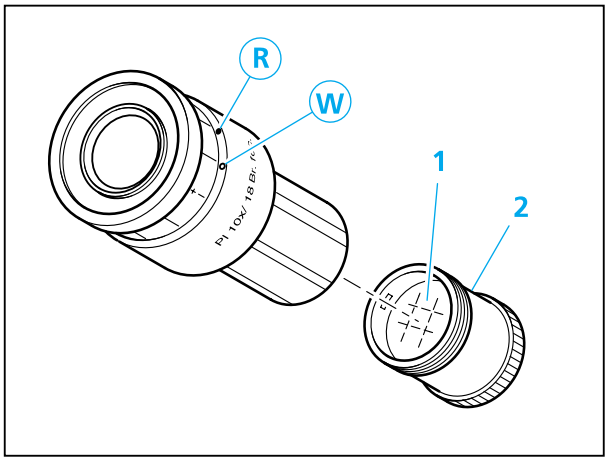

Fig. 2-3 Insertion of eyepiece reticle

The E-PL 10×/20 Br. foc. eyepieces are intended for use with eyepiece reticles (see overview under 1.6).

The slight image shift caused by the additional path through the glass is taken into account on the diopter scale by the fact that the zero point position is indicated not by the white dot (2-3/**W**) but by the red dot (2-3/**R**).

The eyepiece reticles (2-3/**1**) have been adhered to screw-in mounts (2-3/**2**) to allow easy replacement.

- To replace a reticle, unscrew the screw-on mount containing the eyepiece reticle and replace it with the required one.

☞ If eyepiece reticles are inserted into the unscrewed mount by the customer, attention must be paid to the labelling being visible the right way up after insertion.

2.3.2 Compensation of Ametropia when Eyepiece Reticles are used

The correct use of an eyepiece reticle requires two focusing eyepieces, e.g. PL 10×/20 Br. foc., to enable compensation of ametropia.

- Use the eyelens of the focusing eyepiece to focus on the line figure of the eyepiece reticle; focus on the edge of the field of view if no eyepiece reticle is used.
- Focus on the microscope image of a specimen via the focusing drive by looking through the eyepiece with reticle.
- When the image and the eyepiece reticle are in focus in the above eyepiece, focus the image for the second eye via the focusing eyelens of the second eyepiece.

☞ The position of the focusing drive on the stand must not be changed.

2.4 Setting of Interpupillary Distance

- The eyepiece distance is matched to the individual interpupillary distance by swinging the eyepiece tubes symmetrically towards one another. The eyepiece distance can be set in the range between 55 and 75 mm, and you should try to remember the individual value once set.

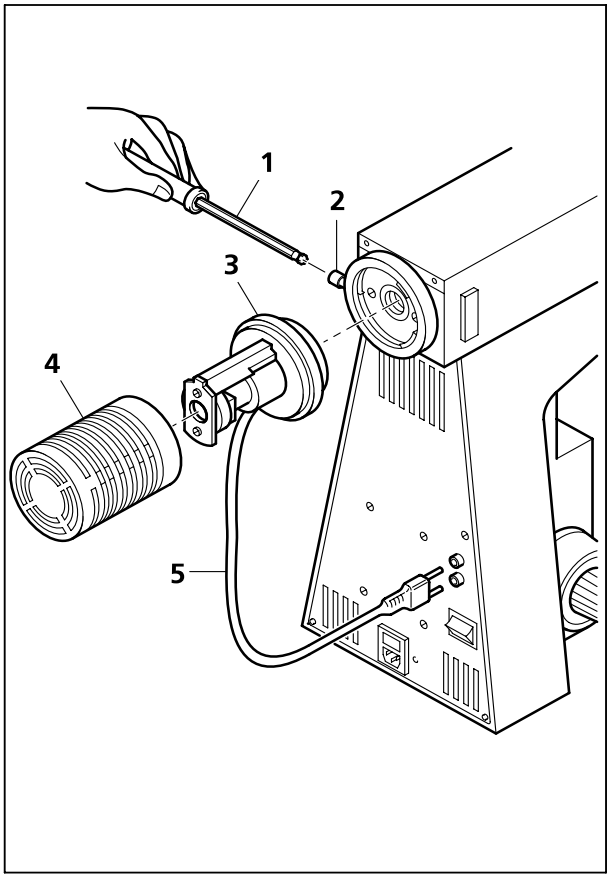

Fig. 2-4 Attachment of reflected-light halogen illuminator

2.5 Attachment of Reflected-Light Halogen Illuminator

- Attach dovetail guide (2-4/**3**) of 6 V, 30 W halogen lamp (2-4/**4**) to the microscope stand and tighten hexagonal screw (2-4/**2**) using the SW 3 screwdriver (2-4/**1**).

☞ The halogen lamp must be mounted to the stand in a vertical position, also see Fig. 3-2.

For visual control, remove lamp cover (2-4/**4**) by slightly turning it to the left.

- Connect cable (2-4/**5**) to the two sockets on the instrument rear.

2.6 Retrofit the Transmitted-Light Halogen Illumination

Transmitted-light observation with the Axiolab A is possible with the configuration described in section 1.3. The pure reflected-light versions of the Axiolab A can also be upgraded for transmitted-light observation by installing the "Retrofit package for transmitted light" (1-4/**7**).

☞ The transmitted-light illumination equipment can be subsequently mounted to the Axiolab A only by Carl Zeiss service personnel.

The transmitted-light illumination package consists of:

- mechanical stage 75 × 35 R/A with ceramic surface and short drive,
- specimen holder with spring clip R,
- transmitted-light illuminator, containing halogen lamp with mount and luminous-field diaphragm with iris,
- ABBE condenser 0.9/1.25 or ABBE condenser 0.9/1.25 with 5-position turret disk

2.6.1 Switch on the Transmitted-Light Halogen Illuminator

☞ Normally, the position of the A/D illumination converter (1-5/**13** or 2-7/**4**) is of no importance with the Axiolab A.

Only if the transmitted-light illumination is a standard feature or has been subsequently installed, the A/D converter will have the following functions:

- the power supply for the reflected-light halogen illuminator is switched on in the upper, pressed position of the converter.
- in the lower, pressed position of the converter, the power supply for the transmitted-light illuminator is switched on.

To change to transmitted-light operation, press the A/D converter (1-5/**13**) at the rear of the Axiolab A into the lower position.
The functions of the on/off switch (1-5/**28**) and the "illuminance" control (1-5/**27**) are retained, regardless of the position of the AD converter A/D (1-5/1**3**) (see section 1.5).

2.7 Equipment of Filter Slider

- Equip filter slider (2-5/**3**) with the filters (2-5/**2**) required for the relevant microscopy technique, e.g. with
  - neutral-density filter N 0.06 (6% transmission)
  - neutral-density filter N 0.25 (25% transmission)
  - conversion filter 3200...5500 K for use of daylight color film
  - narrow-band interference filter, e.g. for contrast enhancement

Insert equipped filter slider in the compartment until it click-stops in the relevant position in the reflected-light illuminator (2-5/**1**).

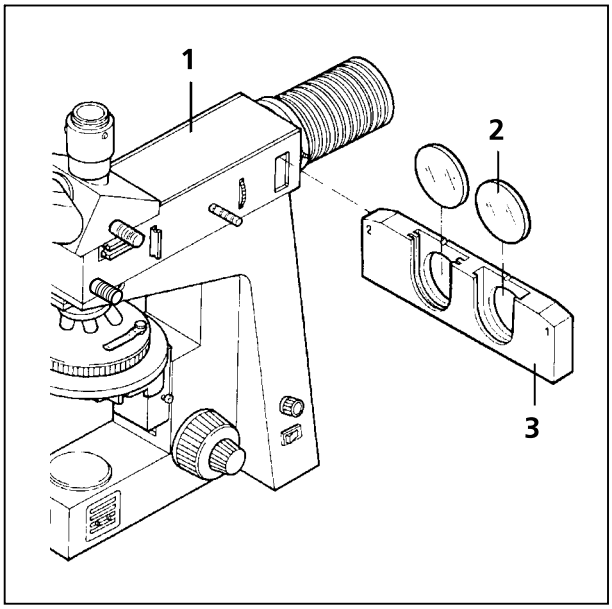

Fig. 2-5 Equipment of filter slider

☞ The filter diameter is 32 mm.

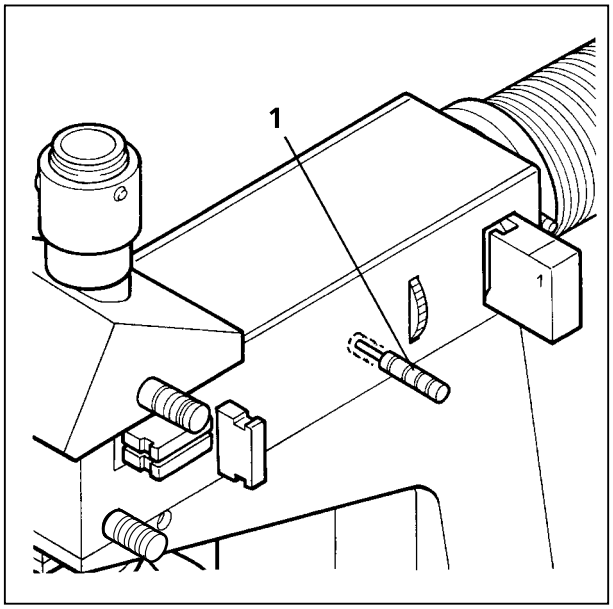

Fig. 2-6 Setting the luminous-field diaphragm

2.8 Set the Luminous-Field Diaphragm

- The pushrod (2-6/**1**) for the luminous-field diaphragm has two positions:
  - pushed in: the full field of view is visible without restriction.
  - pulled out: the visible field of view is reduced to approx. 1/3 of the overall diameter. This can be useful as an aid to find the object plane, i.e. the visible diaphragm is focused. Furthermore, this restriction of the field of view enables reduction of the false light portion of weakly reflecting reflected-light specimens.

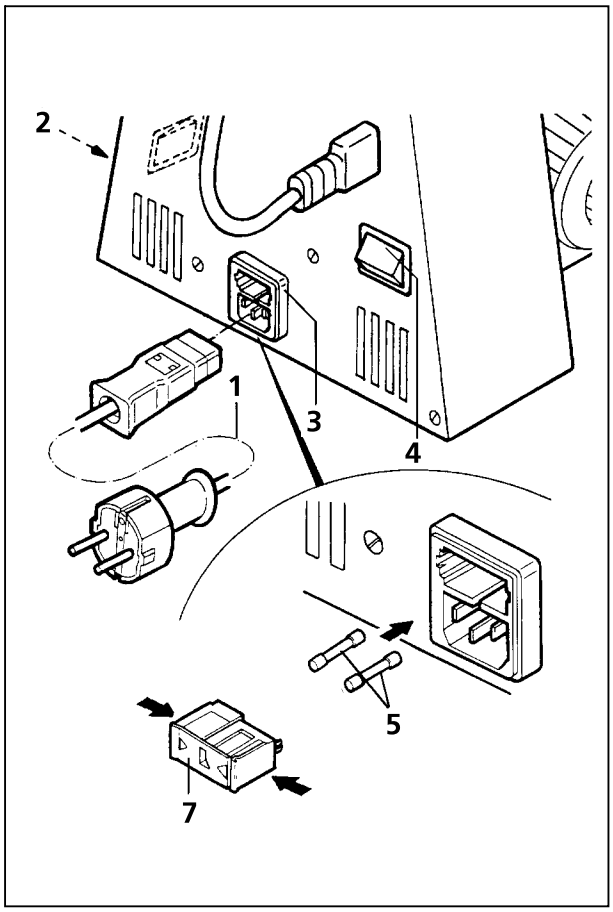

Fig. 2-7 Connecting the instrument to the line

2.9 Connecting the Instrument to the Line

The microscope can be operated using line voltages of 100 – 240 V without conversion

- Connect the line cable (2-7/**1**) with connector to the instrument socket (2-7/**3**) and connect the earth-contact plug to the line.
- Switch on the instrument via the on/off switch (2-7/**2**) on the left-hand side of the instrument.
- The green LED integrated into the on/off switch lights up to indicate that the machine is ready for operation (switch in „I" position). The integrated halogen lamp 6 V, 30 W must also be on.

The change of fuses is described in section 4.2.

OPERATION

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3 OPERATION

3.1 Switch on the Instrument

- Switch on the instrument via the on/off switch (3-1/**6**).
  - – The green line control lamp in the switch (3-1/**6**) must light up.
  - – The halogen lamp 6 V, 30 W in the reflected-light illuminator (3-1/**2**) must light up.

☞ The "**I**" is visible when the on/off switch is switched on and the "**0**" is visible when the on/off switch is switched off.

- Set the required image brightness via the illuminance control (3-1/**5**).
- Depending on what is required, insert attenuation or conversion filter in the filter slider (3-1/**3**) and push the slider in the beam path (also see section 2.7).
- Swing required objective (3-1/**7**) in the beam path; make sure to operate the nosepiece only via the knurled ring.

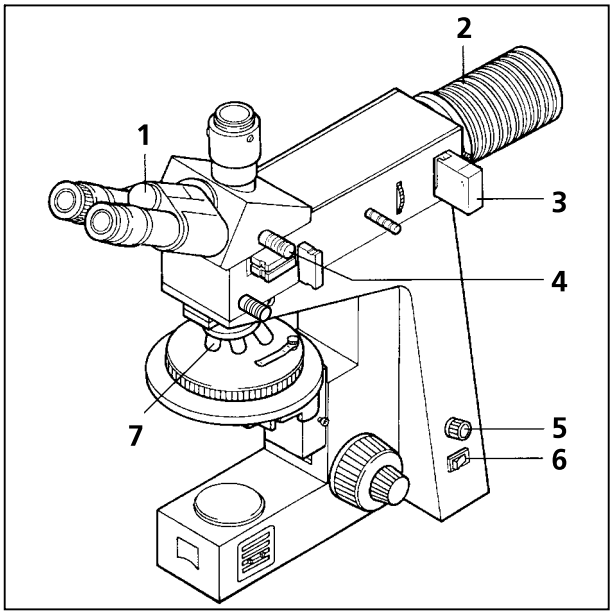


Fig. 3-1 Switch on the instrument

☞ For observation, the pushrod (3-1/**4**) must be pushed in. In this position, 100 % of the light of the beam path is directed to the observation port of the binocular tube (3-1/**1**).

3.2 Illumination and Contrasting Techniques

The description of the illumination and contrasting techniques is based on the following microscope settings:

- The Axiolab A microscope is ready for operation as described in chapter 2 and switched on as described in section 3.1.
- The pushrod (3-2/**3**) has been pushed in to direct 100% of the light to the observation port of the binocular tube.

3.2.1 Setting of Reflected-Light Brightfield

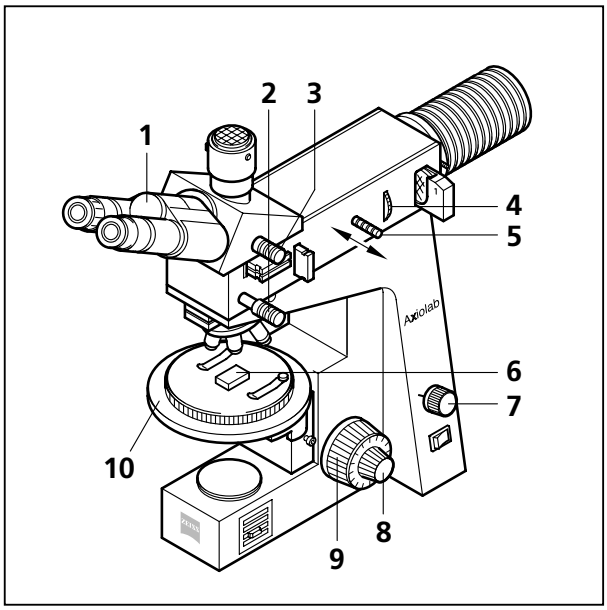


Fig. 3-2 Setting of reflected-light brightfield

- Place a specimen of as much contrast as possible (3-2/**6**) on the specimen stage (3-2/**10**); if required by the specimen height, lower the specimen stage via the coarse drive (3-2/**9**) or secure it in the lower stop position.
- Pull out plane glass pushrod (3-2/**2**).
- Look through the binocular tube (3-2/**1**) and set the eyepiece distance and interpupillary distance again as required (also see section 2.4).
- The aperture diaphragm (3-2/**4**) must be set to approx. half the size of the opening diameter by turning the adjustment wheel downwards.
- Pull out pushrod for luminous-field diaphragm (3-2/**5**) until stop.
- Use the coarse/fine drive (3-2/**9, 8**) focus the circular luminous-field diaphragm now visible in the field of view.
- Insert the pushrod for the luminous-field diaphragm (3-2/**5**) again; the entire field of view is now visible.
- Refocusing on the specimen can be performed via the fine drive (3-2/**8**).
- Use the illuminance control (3-2/**7**) to set the brightness in the field of view to a value agreeable to your eyes.

☞ Depending on the specimen, the contrast is now adjusted via the aperture diaphragm (3-2/**4**). However, the aperture diaphragm cannot be used to control the image brightness (loss in image resolution).

3.2.2 Setting of Reflected-Light Polarization

The Axiolab A microscope is ready for operation as described in chapter 2, and switched on as described in section 3.1.

- Pull out the plane glass pushrod (3-3/**1**).
- Pull out the dust protection sliders (3-3/**2**+**6**) from the reflected-light illuminator H.
- Push polarization slider P (3-3/**3**) into the slider mount (vertical slot) from the right.
- Push rotary analyzer slider A (3-3/**4**) in the upper horizontal slider mount.

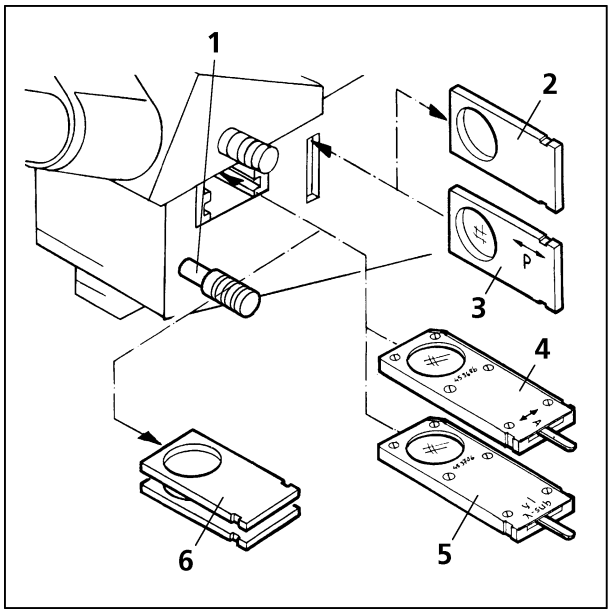


Fig. 3-3 Setting of reflected-light polarization

☞ For reasons of intensity, no filters should be contained in the beam path.

- Set the analyzer slider to optimum contrast (maximum dimming) in the field of view via the adjustment lever.

☞ If possible, this analyzer position should not be changed.

- Reduce illumination aperture by turning the adjusting wheel (3-2/**4**) of the aperture diaphragm downwards.
- To enhance the color contrast of anisotropic object details, the λ-sub compensator slider (3-3/**5**) can be inserted in the lower horizontal slider mount.

  The color intensity can then be varied via the lever on the λ-sub compensator slider.

3.2.3 Setting of Transmitted-Light Polarization with extended Polarization Equipment

The optional, extended polarization equipment includes the following items:

- rotary Pol stage (3-4/**3**)
- Pol object guide (3-4/**4**)
- swing-in polarizer D (3-4/**5**)

(1) Centering of Objectives (only for Axiolab Pol catalogue No. 450910-0000-000)

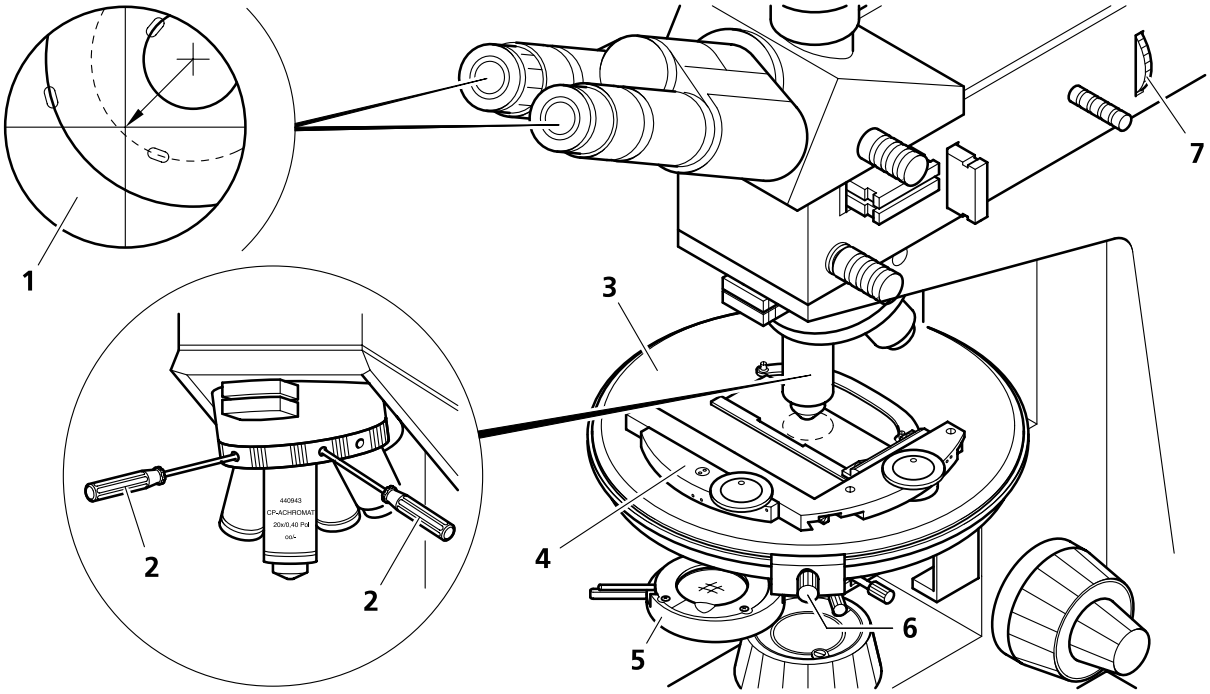


Fig. 3-4 Centering of objectives

When the Pol stage (3-4/**3**) and uncentered objectives are turned, object details above the center of the eyepiece cross migrate to circular paths (3-4/**1** - dashed line). The following procedure is required to center the objectives:

- Unlock the stage stop by turning screw (3-4/**6**) by approx. ¼ rotation in counterclockwise direction.
- Swing in transmitted-light objective of medium magnification (20× - 50×) via the nosepiece.
- Insert SW 1.5 key (3-4/**2**) in the drilled centering holes on the nosepiece.
- Turn the specimen stage and search for the apparent center of rotation (cross (3-4/**1**)). The center of rotation is also the center of the stage rotation.
- Use the keys to move this center of rotation to the intersecting point of the eyepiece crosslines and therefore into the optical axis of the microscope.
- Repeat the procedure with a distinct, small object detail in the direct proximity of the center of the rotary stage.
- Carefully remove the key.
- Swing in the neighboring objective; search for the center of rotation and the distinct object details and perform the adjustment procedure as described above.

☞ To retain the centering status, it is absolutely necessary to change the objectives only via the knurled ring of the objective nosepiece.

(2) Transmitted-Light Polarization - Detection of Birefringence

This technique is used for the examination of transparent, birefringent objects. Birefringence can be recognized, with crossed polarizer and analyzer, by the otherwise dark field of view being brightened 4 times when the specimen stage is rotated about 360°. Respective of birefringence, thickness and orientation of the object, the interference colors range from just visible gray (e.g. in biological objects) to white, yellow, red, blue, etc. and high-order white.

- Set the microscope as usual for brightfield examinations in transmitted light.
- Push in the plane glass pushrod (3-5/**3**).
- Swing in polarizer (3-5/**6**) and set it to 0°.
- Push in analyzer (3-5/**1**) until stop so that the field of view is dark.

☞ When a ± 5° rotary analyzer is used, the analyzer must be in the center stop position.

- Move the object into the field of view and turn the stage (3-5/**4**) containing the object.

☞ Birefringence is indicated by the either colorless or colored brightening of the object. However, optically anisotropic materials can also remain dark if an isotropic direction, e.g. of optically uniaxial or biaxial crystals is oriented parallel to the observation direction. The conoscopic viewing method makes it possible to find out whether the object is isotropic or anisotropic.

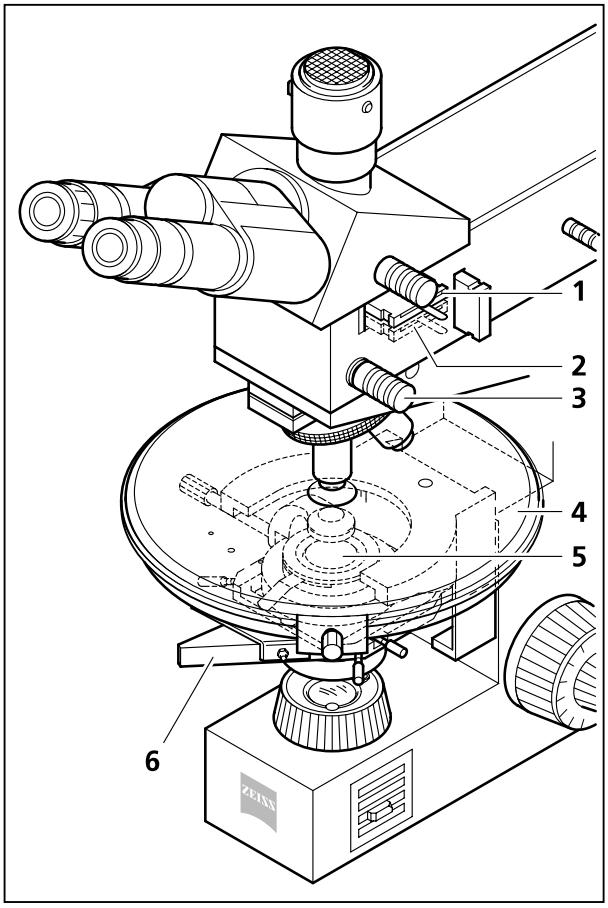


Fig. 3-5 Setting of transmitted-light polarization

(3) Transmitted-Light Polarization - Determination of the $n_{\gamma'}$ Vibration Direction and Determination of the Path Difference

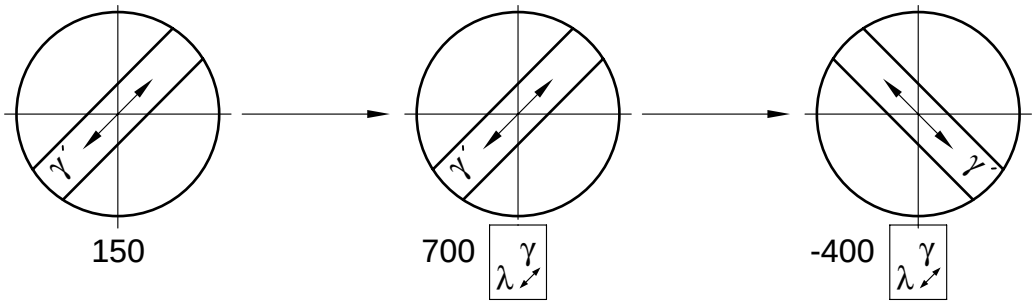


Fig. 3-6 Determine the $n_{\gamma'}$ vibration direction using the example of an artificial fiber

Application

The position of the two directions with the relatively highest ($n_{\gamma'}$) and the relatively lowest ($n_{\alpha'}$) refractive index, or the absolutely highest (n_{γ}) and the absolutely lowest (n_{α}) refractive index, in relation to morphological directions of crystal surfaces, crystal needles or fibers, is an important criterion for recognition. It is also used, for example, for the diagnosis of biocrystals (gout, pseudogout).

Settings

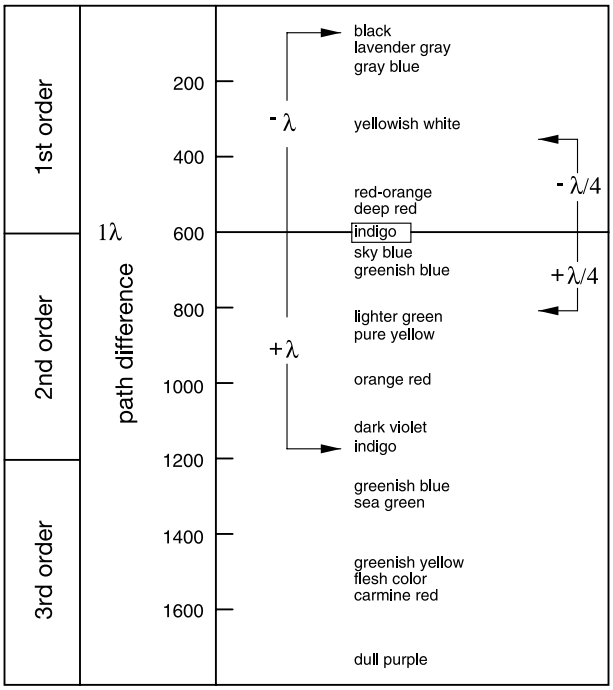


Fig. 3-7 Schematic diagram of the color chart in addition and subtraction position

- Set the microscope as usual for transmitted-light brightfield examinations.
- Turn stage until the first stop position, unlock stop and turn the stage until the object features maximum darkness.
- Activate stage stop mechanism and turn stage around 45° until the next stop so that the longitudinal axis of the fiber is oriented in NE-SW direction.
- Allocate a path difference of approx. 150 nm to this color on the MICHEL LEVY color chart.
  - When the λ-compensator (3-5/**2**) has been pushed in, the color of the fiber changes to yellow-orange (path difference approx. 400 nm).
  - When the stage is turned around 90°, the fiber appears greenish blue (path difference approx. 700 nm).

Conclusions

The n_γ-direction of the λ-compensator is NE-SW oriented. The environment of the fiber exhibits a dark, first-order red (path difference is one λ; approx. 550 nm). The fiber itself appears greenish blue (path difference approx. 700 nm). The higher interference color (700 nm) can only have been created by addition of the path differences of the object (approx. 150 nm) and that of the λ-compensator (approx. 550 nm), while the lower one (approx. 400 nm) must have been created by subtraction.

Addition is possible if n_γ of the compensator and $n_{\gamma'}$ of the object are parallel. Therefore, $n_{\gamma'}$ of the object also lies in NE-SW direction in the case of a higher interference color and is oriented parallel to the longitudinal axis of the fiber.

Summary

Compare the interference colors (path differences) in the two diagonal positions. The higher path difference results if both n_γ-directions are parallel, which defines the $n_{\gamma'}$-direction of the object.

☞ If the thickness of the specimen is known or can be measured, the MICHEL LEVY color chart can be used to determine the birefringence Δn_γ of minerals, synthetic crystals, polymers, strained glass, biocrystals or erythrocytes; starting at the intersection point of the Γ-value and of the thickness d, the inclined line is followed to the outside right up to the edge of the chart.

(4) Transmitted-Light Polarization - Determination of the Optical Character of Crystals

Application

The optical character of transparent and weakly absorbing crystals must be determined for the diagnosis of crystals. The determination is made in conoscopic observation. The main field of application is classical petrography. However, it is also possible to identify and characterize synthetic crystals, industry minerals and plastics (e.g. films).

Settings

- Set the microscope as usual for brightfield and polarization examinations in transmitted light (see Fig. 3-5).
- Swing in low-power objective.
  - In conoscopic observation, those crystals (e.g. of a mineral section) are optimally oriented which alter the brightness least during the stage rotation. In that case, the optical axis of uniaxial crystals or one of the optical axes of biaxial crystals is almost parallel to the observation direction.
- Move one such crystal into the center of the switchable crosslines. Then swing in the objective with the highest dry aperture and the condenser front lens.
- Check whether the condenser stop is fully open and lift the condenser until the image of the luminous-field diaphragm is in focus.
- Now close the field of view diaphragm until the grain borders of the selected crystal are no longer visible. This avoids the axis image of the examined crystal being overlaid by axis images of neighboring crystals. Object details up to dia. 10 µm can thus be faded out.

  When the stage is turned, the object must be oriented to the center of the crosslines, i.e. it must remain within the examination area.
- Replace one eyepiece with the diopter pinhole or the auxiliary lens.
- Focus the axis image (pupil image).
  - The set conoscopic image shows whether the crystal is uniaxial or biaxial.

Uniaxial Crystals

If the optical axis of a uniaxial crystal is oriented parallel to the observation direction, a dark cross which can be surrounded by concentric interference rings (depending on birefringence and specimen thickness) becomes visible in the conoscopic observation mode. These interference rings are also called isochromats (from the Greek isos = equal and chroma = color).

The cross is maintained when the stage is turned. Observe the NE quadrant of the cross (1st quadrant; counting is made counterclockwise).

If you use the λ-compensator:

- After insertion of the λ-compensator, the following appears in the first and third quadrant near the center of the dark cross:
  - yellow = optically negative
  - blue = optically positive

Biaxial Crystals

If biaxial crystals show a cross in conoscopic observation which is resolved into two hyperbola legs when the stage is turned, the acute bisectrix (1st center line) is oriented parallel to the observation direction. Turn the stage until the dark hyperbola legs (isogyres) are in the first and third quadrant.

If you use the λ-compensator:

- The following appears after insertion of the λ-compensator:
  - yellow = optically negative
  - blue = optically positive

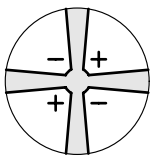
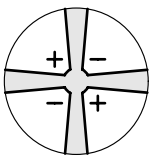
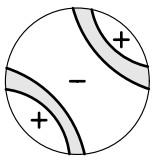
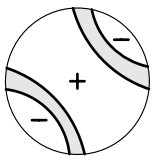
	optically uniaxial		optically biaxial		
	positive	negative	positive	negative	
λ plate (white → blue → yellow)					+ = blue – = yellow

Fig. 3-8 Determine the optical character of crystals

☞ If one optical axis of a biaxial crystal is oriented parallel to the observation direction, only one hyperbola leg is visible in conoscopic observation, the vertex of which lies in the center of the field of view. When the stages are turned, the hyperbola leg moves around its vertex. The determination of the optical character is performed in the same way.

(5) Reflected-Light Polarization - Detection of Bireflection and Reflection Pleochroism

Application

Polished sections of ores, coals, ceramic products, certain metals and metal alloys display a different reflection behavior, depending on the orientation of the crystals or the object details. Therefore, this technique also represents a further contrasting method.

Bireflection

- Set the microscope as usual for examinations in reflected-light brightfield (see section 3.2.1)
- Pull out plane-glass pushrod (3-3/**1**).
- Insert polarization slider (3-3/**3**) until stop.
- Insert analyzer slider (3-3/**4**); adjusting lever in center position.
- Close aperture diaphragm (3-4/**7**) by 2/3 of its diameter.
  - The object displays bireflection if any object details feature differences in brightness and color which vary when the stage is rotated.

Reflection Pleochroism

- Pleochroism can be recognized by color changes in the object after stage rotation (reflected-light polarizer slider (3-3/**3**) pushed in, analyzer slider (3-3/**4**) pulled out). (Rotary λ-compensator pulled out)

3.2.4 Setting of Epi-Fluorescence

The fluorescence technique allows fluorescent structures to be visualized with high contrast in a typical fluorescence color. The examined material can be autofluorescent or may have been mixed with fluorescent substances (fluorochromes).
The epi-fluorescence technique can be performed using equipment for simple fluorescence examinations with the Axiolab A, together with the 6 V, 30 W halogen illuminator (3-9/**1**) and the standard brightfield beam splitter.

The equipment consists of:

- a special FL filter slider (3-9/**2**) which is inserted in the reflected-light illuminator H instead of the standard filter slider.
- a dia. 25 excitation filter (3-9/**3**) especially for the blue excitation of Epodye.
- a dia. 25 barrier filter (3-9/**5**) especially matched to this excitation filter, which is inserted in one of the two dust protection sliders (3-9/**6**).

☞ This technique requires much light. Turn the "illuminance" control (3-9/**7**) to its right stop, fully open aperture diaphragm (3-9/**4**) via the adjusting wheel.

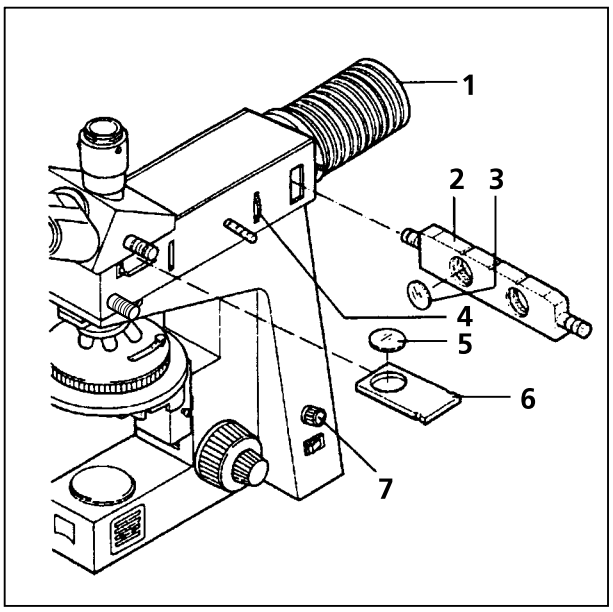


Fig. 3-9 Setting of epi-fluorescence

3.2.5 Setting of Transmitted-Light Brightfield (KÖHLER Illumination)

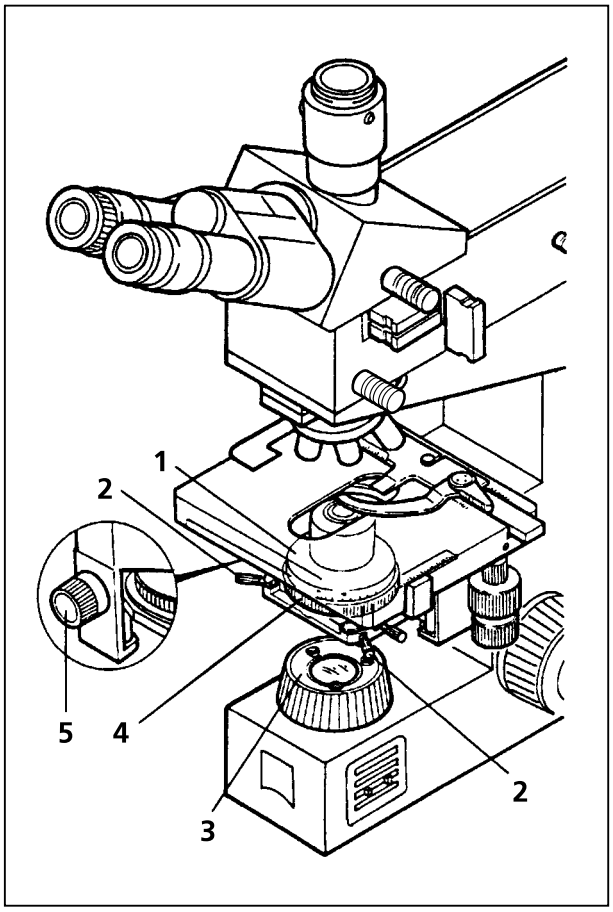


Fig. 3-10 Setting of transmitted-light brightfield

Make the microscope ready for operation as described in chapter 2 and section 3.1.

- Switch on the illumination, place a high-contrast specimen on the stage, and focus using the 10× objective.
- Close luminous-field diaphragm (3-10/**3**) via the knurled wheel.
- Use drive (3-10/**5**) to move ABBE condenser close to the upper stop position until the image of the luminous-field diaphragm appears in focus.
- Use the centering screws (3-10/**2**) to move the luminous-field diaphragm to the center of the field of view.
- Open the luminous-field diaphragm until its edge just disappears from the field of view.
- Control the contrast via the aperture diaphragm (3-10/**4**), which should be open by approx. 2/3 of its size (marking on condenser positioned to 0.5).

For further information on the use of the Axiolab A for transmitted-light examinations and the relevant accessories please see the manual Axiolab - Transmitted Light and Epi-Fluorescence (G 42-130/II e).

3.3 Attachment of Microscope Stages and Specimen Holders

The Axiolab A microscope is available with three different stages:

- fixed stage (3-11/**1**),
- gliding stage (3-11/**2**) or
- mechanical stage (3-11/**3**).

The retaining clips (3-11/**4**) are used to hold specimens mounted on a 26 × 76 mm microscope slide. They are inserted into the drilled holes in the specimen stage.
With the mechanical stage, the specimen holder with spring clip "R" (3-11/**5**) is used to guide the above slides. For the examination of opaque objects, the mechanical stage can be equipped with the specimen holder A (3-11/**6**).

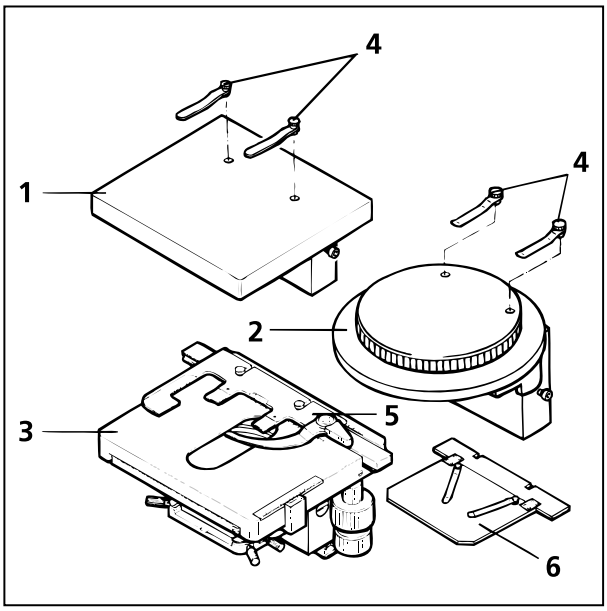


Fig. 3-11 Stage selection

The stages can be changed by the users themselves:

- Loosen hexagonal screw (3-12/**2**) on the right side of the stage until the stage (3-12/**1**) can be removed from the dovetail (3-12/**3**).
  The stage can be attached again and fixed in reverse order.

☞ If the maximum specimen height is 20 mm, the stage is secured in the upper stop position; for higher specimens, the lower stage stop must be used (specimen height up to max. 45 mm).

The mechanical stage can be secured only in the upper stop position, and therefore only allows specimen heights up to 20 mm (only 18 mm with specimen holder A).

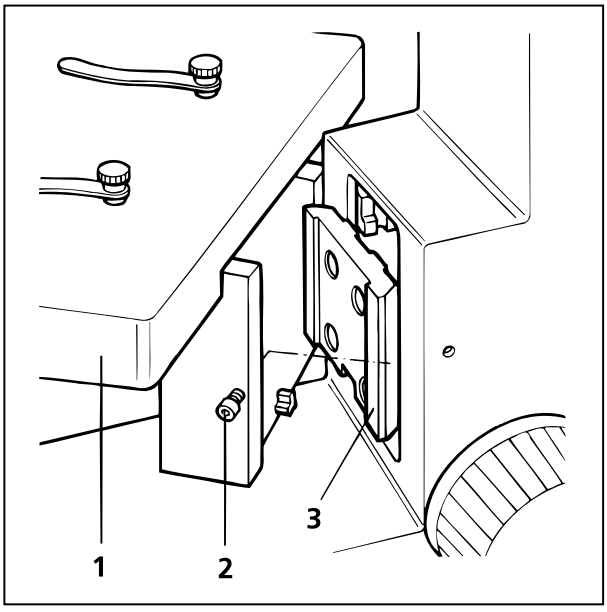


Fig. 3-12 Changing the microscope stage

3.3.1 Attachment of Pol Rotary Stage

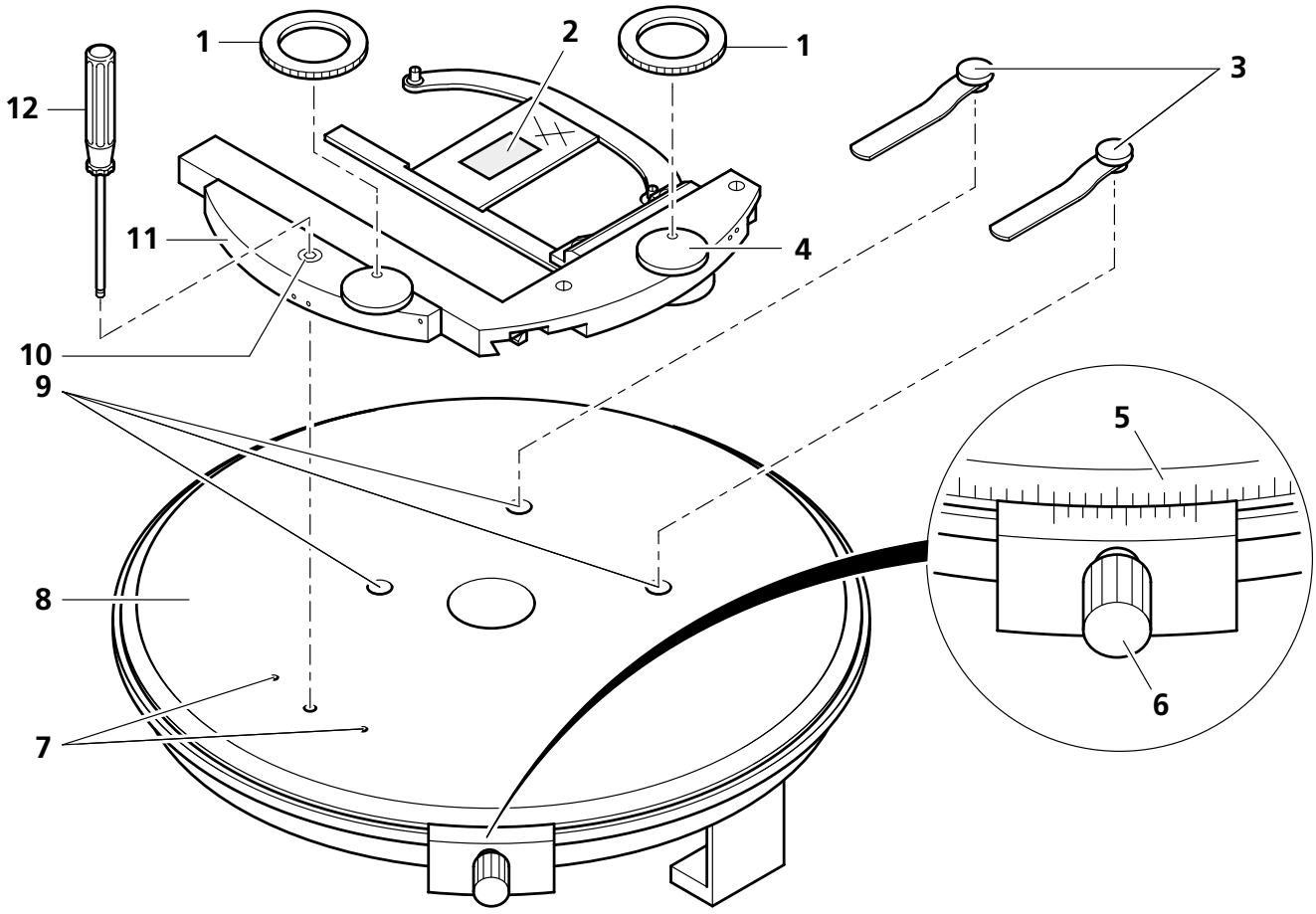


Fig. 3-13 Pol rotary stage- setting of specimen mount and stop

The stage clips (3-13/**3**) are used to mount the specimen on the Pol rotary stage (3-13/**8**). They are inserted into two of the three drilled holes (3-13/**9**) and, depending on the size of the specimen carrier or the search area, used diagonally, opposite to each other or parallel.
The Pol object guide (3-13/**11**) (accessory 473325-0000-000) provides a more convenient possibility. It is inserted in the drilled holes (3-13/**7**) and secured using the screw (3-13/**10**). For this purpose, use the ball-headed screwdriver (3-13/**12**) supplied. The plastic rings (3-13/**1**) increasing the knob diameter (3-13/**4**) for convenient operation from the side are particularly beneficial for screening.

☞ To obtain a maximum screening area with the 24 × 48 specimen carrier size, mount the specimen as shown in Fig. (3-13/**2**).

3.4 Use of Polished Section Attachment

The polished section attachment from the line of accessories provides another possibility of holding objects for examinations in incident light. It has been intended for use with the gliding stage.

☞ Basically, the polished section attachment can also be used with the fixed stage. Use a screwdriver to remove the two bolts (3-14/**5**) on the underside and place the attachment on the fixed stage without any securing elements.

The polished section attachment accommodates specimens of any shape with **one** processed (ground and polished) surface and aligns them parallel to the stage surface.

- Gliding stage (3-14/**6**) - or also fixed stage - at the lower stop.
- Remove magnetically held plate (3-14/**1**) from the polished section stage (3-14/**4**).
- Remove both retaining clips and insert two bolts (3-14/**5**) of the polished section stage (3-14/**4**) into the drilled holes of the gliding stage (3-14/**6**).
- Use the retaining clip (3-14/**3**) to fix the polished section (3-14/**2**) to the plate (3-14/**1**) from below.
- Attach the specimen assembly to the premounted polished section attachment.

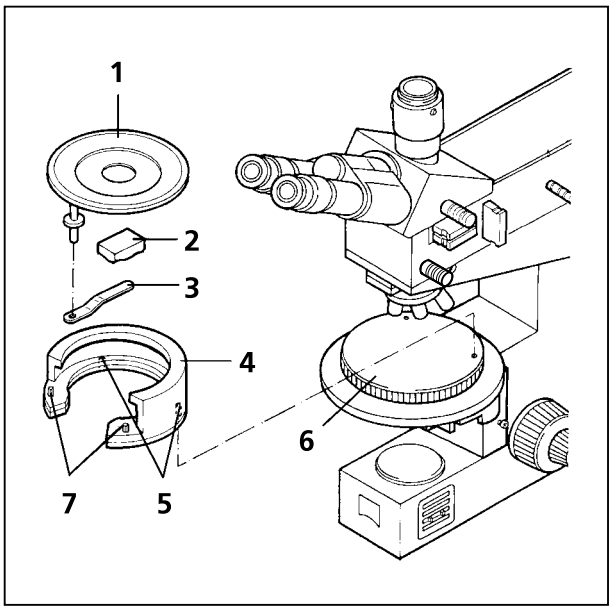


Fig. 3-14 Use of polished section attachment

- The two knurled screws (3-14/**7**) permit the attachment to be slightly tilted towards its support. Should the microscope image be unilaterally out of focus in the field of view, this can be remedied by slightly changing the tilt of the attachment.

3.5 Photomicrography and Videomicroscopy

The Axiolab A microscope can be changed from observation to photomicrography or videomicroscopy via a pushrod (3-16/**7** or 3-18/**8**) (pushrod pulled out for photomicrography or videomicroscopy). Since this is a 100% changeover, simultaneous observation and photography is not possible.

Special adapters allow commercially available 35 mm cameras or microscope cameras (e.g. MC 80 DX) to be attached to the camera port of the Axiolab A. For the use of photomicrography equipment please see the relevant manuals.

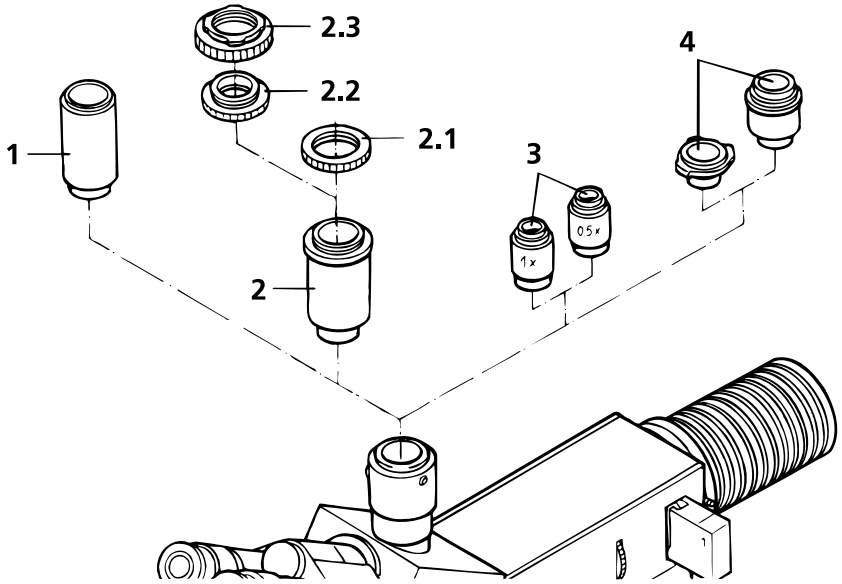


Fig. 3-15 Attach various camera systems to the Axiolab A phototube

3.5.1 Attachment of Photomicrography Equipment

(1) Attachment of SLR Camera, e.g. CONTAX 167 MT

- Screw T2 adapter for the CONTAX bayonet (3-16/**3**) on the 2.5× connector for T2 (3-16/**4**) (456005-0000-000).
- Attach the camera housing (3-16/**2**) and the cable release (3-16/**1**), if required.
- Loosen the three hexagonal screws (3-16/**6**) to remove the dust cover (3-16/**8**) from the camera tube (3-16/**5**) and insert the premounted unit A in the camera tube.
- Align the camera unit in the required position and tighten the three hexagonal screws (3-16/**6**).
- Pull out pushrod (3-16/**7**) completely for photomicrography.
- When artificial-light color reversal film is used, the CB 3 conversion filter provides the correct color temperature of 3200 K.
- For daylight color reversal film, the CB 12 conversion filter must be used in addition to the CB 3 conversion filter.

☞ If focusing is not to be made via the viewfinder of the camera, the component with the eyepiece reticle must be screwed in the eyepieces (see sections 1.5 and 2.3.1).

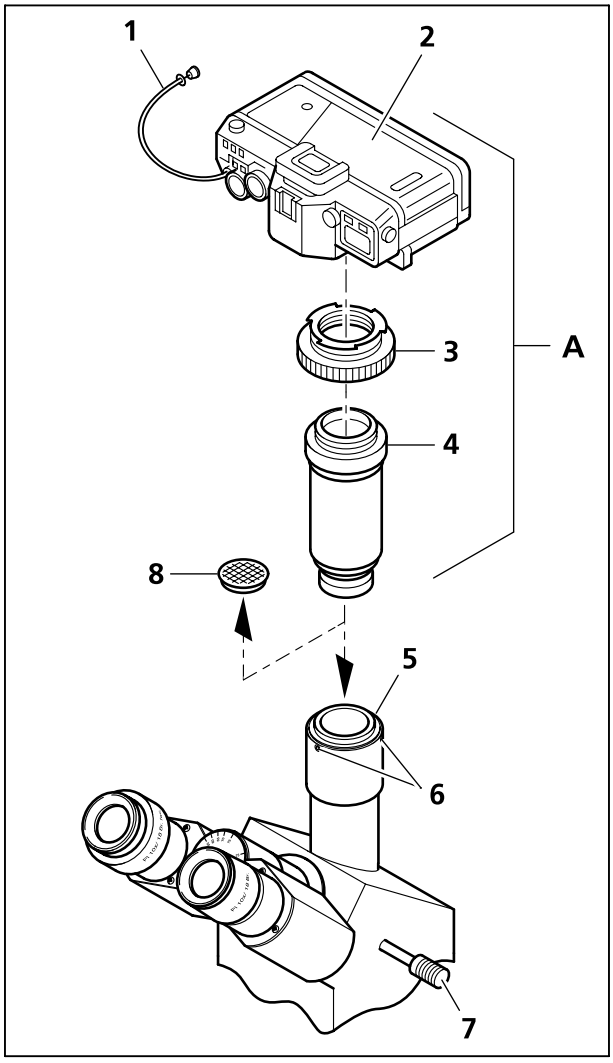


Fig. 3-16 Attachment of SLR camera, e.g. CONTAX 167 MT

Various T2 adapters for SLR cameras are listed below:

T2 adapters to SLR cameras	**Cat. No.**
T2 adapter for CONTAX (CONTAX bayonet)	416010-0000-000
T2 adapter for OLYMPUS OM (OM bayonet)	416002-0000-000
T2 adapter for MINOLTA (SR bayonet)	416003-0000-000
T2 adapter for CANON (FD bayonet)	416004-0000-000
T2 adapter for NIKON (F bayonet)	416009-0000-000
T2 adapter for PENTAX (KA bayonet)	416011-0000-000

☞ For detailed information on SLR cameras please see operating manual from Carl Zeiss B 40-046 e entitled "Photomicrography with 35 mm SLR Cameras".

(2) Attachment of MC 80 DX Microscope Camera (35 mm Film Cassette)

- Insert adapter 60 for microscope camera (3-17/**5**) (456006-0000-000) in camera tube (3-17/**6**) and fix it using three hexagonal screws (3-17/**7**).
- Insert projection lens P 2.5× (3-17/**4**) in adapter 60 for microscope camera (3-17/**5**).
- Attach MC 80 DX basic body (3-17/**2**) on adapter 60 for microscope cameras until stop and fix it by clamping ring (3-17/**3**) anticlockwise.
- Attach 35 mm film cassette Mot DX (3-17/**1**) to the basic body in such a way that the contact pins firmly engage in the relevant sockets.
- Pull out pushrod (3-17/**8**) completely for photomicrography.
- When artificial light color reversal film is used, the CB 3 conversion filter provides the correct color temperature of 3200 K.
- For daylight color reversal film, the CB 12 conversion filter must also be used.

☞ For detailed information on the MC 80 DX, please see operating manual from Carl Zeiss B 40-036 e, "MC 80 DX Microscope Camera".

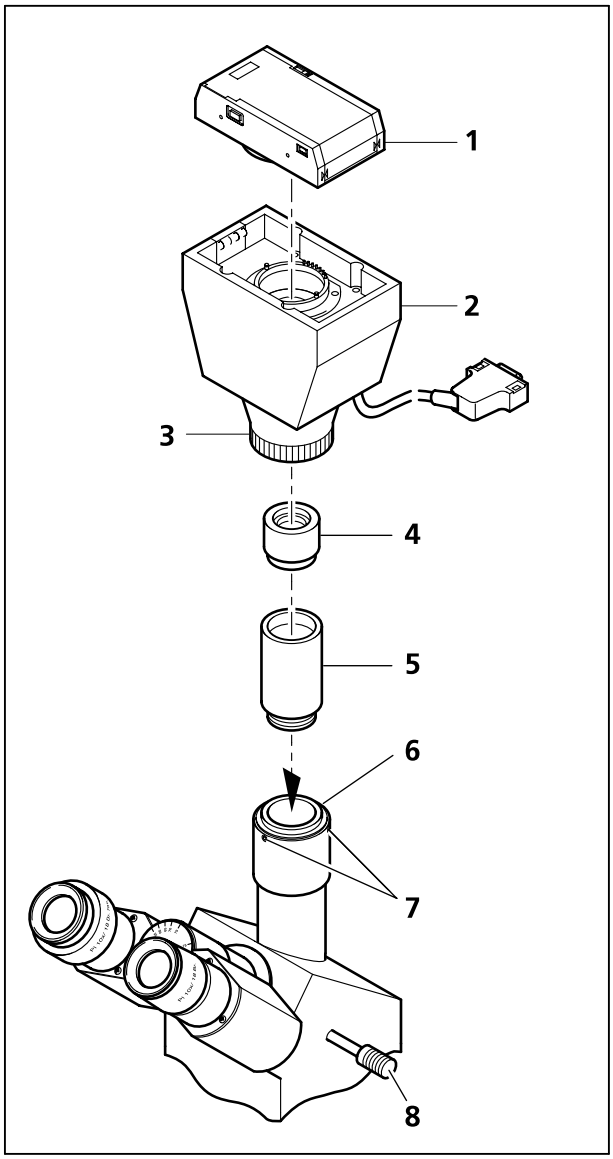
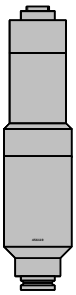
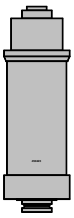
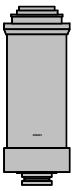
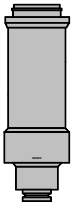
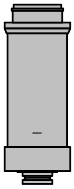
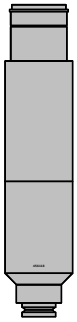


Fig. 3-17 Attachment of MC 80 DX

3.5.2 Attachment of Adapters for Video Cameras

The following video adapters with 60 mm interface permit the attachment of one-chip b/w and color CCD cameras and 3-chip color CCD cameras to the camera port of the Axiolab A.

Tube	Adapter	Cameras
AXIOLAB A REFLECTED-LIGHT TUBE WITH 60 MM INTERFACE	**456105** 60 C 2/3" 1.0×	**456107** 60 C 2/3" 0.63×	**456106** 60 C 1/2" 0.5×	CAMERAS WITH C-MOUNT
	 **456119** 60 C 1/3" (3CCD) 0.5×	**456108** 60 C 1/3" 0.4×	 **456123** Zoom 60 C 2/3" 0.4× ... 2×	
	456115 60 ENG 2/3" 1.0×	**456117** 60 ENG 2/3" 0.8×	 **456121** Zoom 60 ENG 2/3" 0.4× ... 2×	3-CHIP CAMERAS WITH 2/3" BAYONET
	 **456124** Zoom 60 ENG 1/2" 0.5× ... 2.4×	 **456122** Zoom 60 ENG 1/2" 0.4× ... 2×	 **456118** 60 ENG 1/2" 0.63×	3-CHIP CAMERAS WITH 1/2" BAYONET

Attachment of video cameras:

- Loosen three hexagonal screws and remove dust cover from the Axiolab A camera tube.
- Screw video adapter or video zoom adapter with C-mount thread into the video camera.
  Insert video adapter or video zoom adapter in ENG 2/3" or ENG ½" bayonet of the video camera and clamp it tight.
- Insert premounted unit (video camera with video adapter or video zoom adapter) in the camera tube of the Axiolab A, align it and fix it using the three hexagonal screws.
- Set the required zoom magnification factor via the wheel of the video zoom adapter.
- If required, adjust image brightness on the monitor by changing the lamp brightness on the microscope stand.

☞ The instructions of the camera manufacturer must also be observed when operating the video camera.

3.6 Insertion of 8× Drawing Eyepiece

The 8× drawing eyepiece (444126-0000-000) is an accessory for microscopic drawing and can only be used in combination with the binocular reflected-light tube 30°/20 H[1] on the Axiolab A. It contains a beam splitter which allows the simultaneous observation of the microscope image and the drawing area.

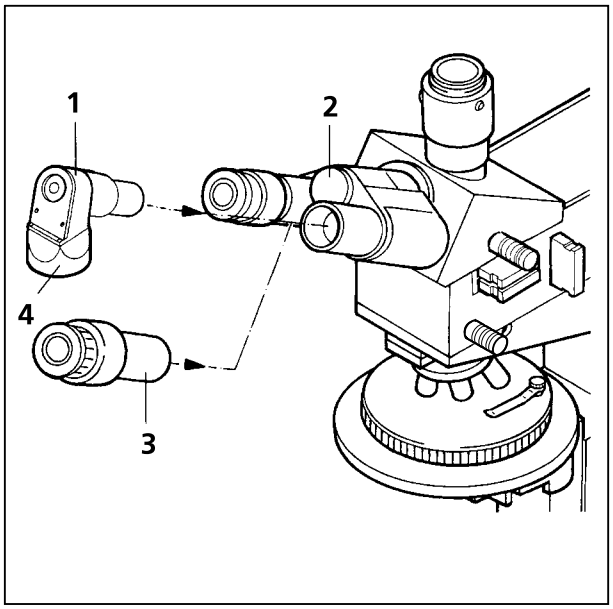


Fig. 3-18 Insertion of 8× drawing eyepiece

Switch on the microscope as described in section 3.2 and set it for reflected-light brightfield according to section 3.2.1.

- Remove one eyepiece (3-18/**1**) and insert the 8× drawing eyepiece (3-18/**3**) in the binocular reflected-light tube 35°/20 (3-18/**2**) until stop. Swing 8× drawing eyepiece until the drawing area (DIN A4 notepad) lying in front of the stand appears symmetrically aligned also in the field of view.
- Screw on the drawing eyepiece.
- Illuminate the drawing area in such a way that it can be seen in the same quality as the microscope image. If required, reduce the brightness of the microscope image via the illuminance control (3-2/**7**).
- A special drawing pencil is supplied to facilitate drawing.

☞ If the image on the drawing area is too dark, an additional desk illuminator should be installed. We would recommend the use of spotlights with a homogeneous area illumination (dia. 250 mm).

We would also recommend you to use a support for the drawing area, which should be 20 mm thick. This is the only way to ensure that the exact distance to the drawing eyepiece is kept.

[1] 30°/20 means a viewing angle of 30° and the maximum field number 20.

CARE, TROUBLESHOOTING AND SERVICE

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4 CARE, TROUBLESHOOTING AND SERVICE

4.1 Maintenance of the Instrument

Maintenance of the Axiolab A is limited to the following operations:

- Cover the instrument with the dust cover after every use.
- Do not set up the instrument in a damp room, i.e. max. humidity < 85%.
- Remove dust from optical surfaces using a rubber blower or a natural hair brush. Use alcohol to remove grease from brush, then dry the brush. Remove stubborn dirt and fingerprints using a dust-free cloth or leather cloth.
- Remove stubborn dirt (e.g. fingerprints) from optical surfaces using commercially available optics cleaning cloths; if necessary, slightly moisten the cloths with petroleum ether. Clean the front lenses of the objectives using petroleum ether, but do not use alcohol.

When using the Axiolab A in humid climatic zones, proceed as follows:

- Store the Axiolab A in bright, dry and well ventilated rooms with a humidity of less than 85%; store particularly sensitive components and accessories, such as objectives and eyepieces, in a dry closet.
- When the equipment is stored in closed cases for a longer period of time, the growth of fungus can be avoided by including cloths soaked in fungicide in the cases.

The risk of growth of fungus on opto-mechanical instruments always exists in the following conditions:

- relative humidity of more than 75% and temperatures between +15° C and +35° C for more than three days.
- installation in dark rooms without air ventilation, and
- dust deposits and fingerprints on optical surfaces.

4.2 Troubleshooting

Troubleshooting on the Axiolab A microscope is limited to only a few actions:

- Checking the line cable
- Checking the set instrument voltage and changing the fuses
- Checking the illumination and changing the lamp
  - Defective fuse(s) → change the fuses according to paragraph (**1**)
  - defective halogen lamp → change the lamp according to paragraph (**2**) or (**3**)

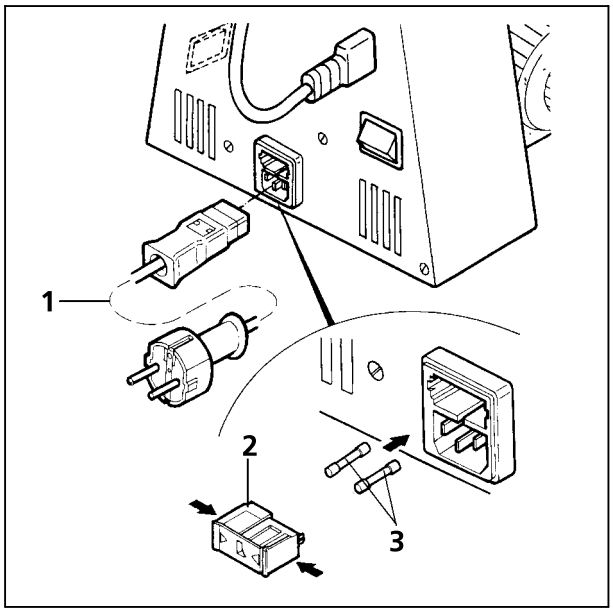

Fig. 4-1 Changing the fuses

(1) Check the Line Cable and Fuses and Change Fuses

Make sure to disconnect the instrument from the line first!

- Check line cable (4-1/**1**) and replace it, if required.
- Use 2.0 mm watchmaker's screwdriver to press the two springs at the side of the fuse holder (4-1/**2**) to the inside via the groove and remove fuse holder.
- Check fuse inserts (4-1/**3**) and replace defective fuses with new ones. Make sure to use only T 0.8 A; 250 V; 5 × 20 mm fuses!
- Insert fuse holder again until the springs at the side can be heard to engage.
- Connect the instrument to the line.

(2) Changing the 6 V, 30 W Reflected-Light Halogen Lamp

The following procedure is required to change the lamp of the 6 V, 30 W reflected-light halogen illuminator:

- Switch off the lamp supply; if required, allow the illuminator to cool down for approx. 15 minutes.
- Disconnect the line cable from the line.
- Remove the connection cable of the reflected-light illuminator from the socket at the rear of the instrument.
- Turn the cover (4-2/**3**) to the left and remove it in backward direction.
- To facilitate the lamp change, loosen the hexagonal screw (4-2/**1**) by a few turns and remove the mount (4-2/**2**) from the reflected-light illuminator (the tools are listed together with the accessories)

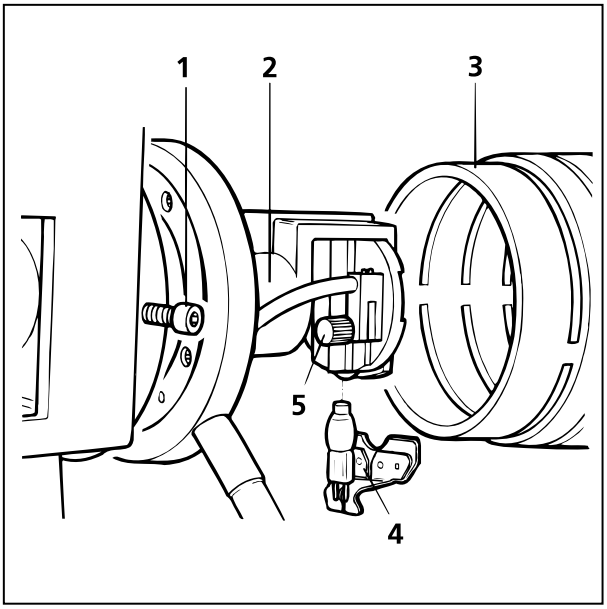

Fig. 4-2 **Changing the 6 V, 30 W reflected-light halogen illuminator**

- Loosen both fixation screws (4-2/**5**) by turning them to the left and remove the carrier plate (4-2/**4**) containing the lamp.
- Remove new 6 V, 30 W halogen lamp from the packaging and insert it into the mount (4-2/**2**); one tip of the ceramic base must engage in the centering notch of the carrier plate, and the carrier plate must fit well to the second tip.

☞ Do not touch the lamp bulb with your bare hands; if required, clean the bulb using pure alcohol **before** switching it on for the first time to prevent dirt from burning in.

- Attach reflected-light illuminator again in such a way that the halogen lamp is positioned vertically. Tighten hexagonal screw (4-2/**1**).
- Attach cover (4-2/**3**) and lock it by turning it to the right.
- Connect the cable of the reflected-light illuminator to the rear of the microscope stand.

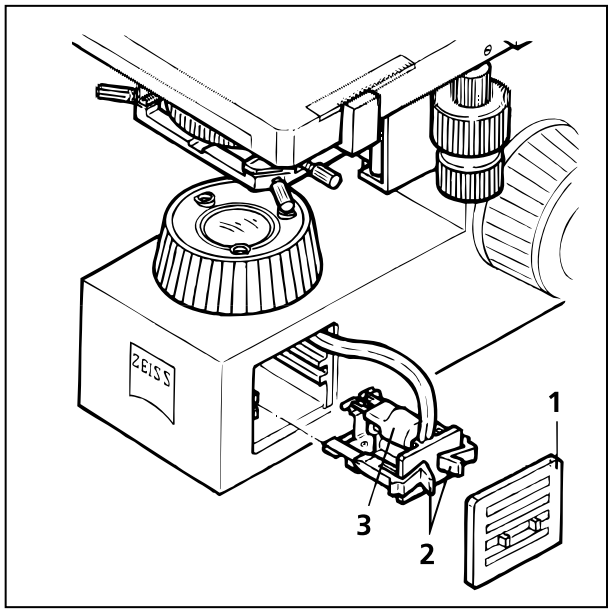

Fig. 4-3 Changing the 6 V, 30 W transmitted-light halogen lamp

(3) Changing the 6 V, 30 W Transmitted-Light Halogen Lamp

The following procedure is required to change the lamp of the integrated 6 V, 30 W illuminator:

- Switch off the extern lamp supply; if required, allow the illuminator to cool down for approx. 15 minutes.
- Disconnect the line cable from the line.
- Hold the ventilation grille (4-3/**1**) on its grip and pull it off in upward direction.
- Remove the lamp insert by pressing its handle (4-3/**2**) together.
- Replace the halogen lamp 6 V, 30 W (4-3/**3**).

☞ Do not touch the lamp bulb with your bare hands; if required, clean the bulb using pure alcohol **before** switching it on for the first time to prevent dirt from burning in.

- Make sure that the lamp carrier plate exactly fits the positioning pins.
- Attach lamp insert again by slightly pressing the handle together
- Attach ventilation grille again until stop.

4.3 Requesting Service

All repairs of mechanical, optical or electronic components inside the instrument and of the electrical components of the Axiolab A may only be performed by Carl Zeiss service staff or specially **authorized** personnel.

To ensure the optimum setting and trouble-free function of your microscope even for a longer period of time, we would recommend you to conclude a service/maintenance contract with Carl Zeiss.

In the case of subsequent orders or when service is required, please get in touch with your local Carl Zeiss agency.

Annex

- List of Abbreviation A-3
- Certification in Accordance with DIN EN ISO 9001 / DIN EN 46001 ..... A-5
- EC Conformity Declaration A-7

List of Abbreviations

A	incident light, analyzer
AC	Alternating Current
Br.	eyepieces suitable for spectacle wearers
CCD	Charge-Coupled Device
CSA	Canadian Standards Association
D	transmitted light, filter attenuation in %
DIN	German Standards Association
Dmr, d	diameter
DX	coding system for electronic data, e.g. film speed
EG	European Community
EMV	electromagnetic compatibility
EN	European standards
ENG	Electronic News Gathering
E-PL	name of eyepiece type Epiplan
FAA	free working distance
FL	fluorescence
foc.	focusing
HBO	mercury vapor short-arc lamp
HF	brightfield
Hg	mercury
HLW	halogen lamp
ICS	Infinity Color corrected System
IEC	International Electrotechnical Commission
IP	International Protection
M	metric thread
MC	Microscope Camera
NO	North-East
OZ	item number
P	polarizer
PL	plane
Pol	polarization
R	right
SLR	Single Lens Reflex
SK	protection class
SW	wrench opening, South-West
VDE	Association of German Electrotechnicians (Verband Deutscher Elektrotechniker)

T	slow-blow fuse type
TV	television
T2-Adapter	standard adapter for 35 mm cameras